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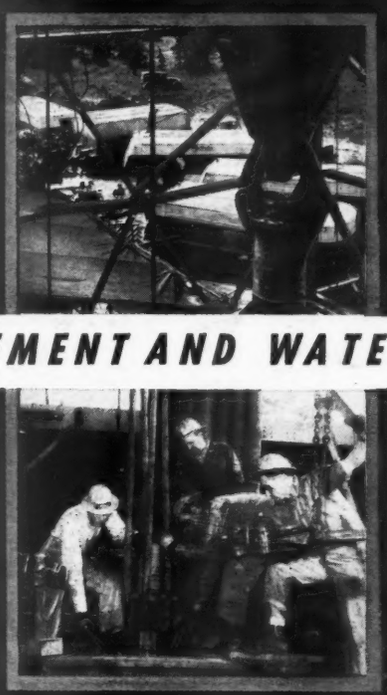

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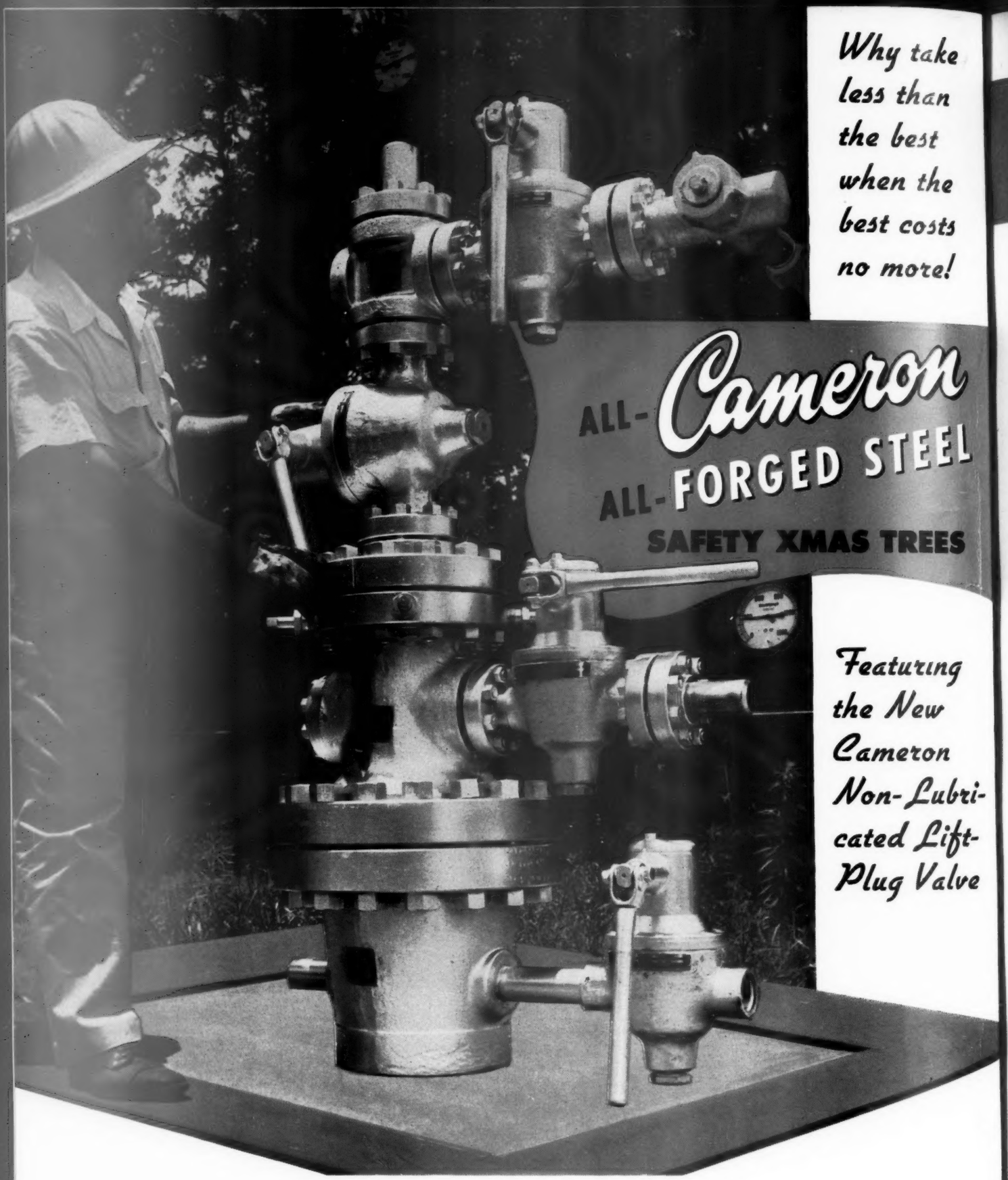

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Indexed by Industrial Arts Index and The Engineering Index, Inc.

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the Course of OIL

ENGINEERING PERSONNEL

ENROLLMENTS in engineering colleges have been falling off, largely due to a widely and erroneously held belief that engineers were in oversupply. In the present emergency there is fear of drafting engineers in positions for which their engineering training and experience are not mandatory. Already there is evidence of a critical shortage of engineers and other technically trained personnel in many branches of industry. It is estimated that in normal peace time 20,000 graduates in engineering are required by industry annually. In each of the last two years 50,000 engineers were graduated from colleges throughout the country and all were absorbed by industry. This large number included engineers whose engineering education was delayed or interrupted by the war. Enrollments of engineering students are now showing a startling decline. Under present draft regulations there is likely to be a further drastic drop in enrollments. A minimum of at least 30,000 new graduate engineers annually are needed in industry for the emergency. To obtain this number requires an annual freshmen enrollment of 60,000, or more than twice the number of engineering students entering this year. The total enrollment of all students in the colleges of the nation in 1950 was 6.6 per cent less than in 1949, but engineering enrollments for the same period were 20 per cent less.

These are facts revealed by the Manpower Committee of the American Society for Engineering Education, which has recently completed a study of the problem. It is not an encouraging picture. If the trend continues, industry may not be able, under the present emergency program, to meet our civilian needs, to say nothing of military demands. This impending scarcity of engineering and technical talent becomes a matter of grave concern to industry. It demands that engineering personnel be used to the best possible advantage and in the most effective manner possible. It is a manpower problem the military and other government agencies must recognize. Engineering manpower needs of the military and of industry must be so coordinated that the limited supply of personnel will be used to the best advantage.

Industry must support the military, but to assume the military needs are paramount or exclusive could be a form of national suicide. A careful planning for utilization of men with engineering training and experience only in categories where such training and experience are mandatory should be undertaken. This objective should be approached as closely as possible. Sound policies relating to deferments and the calling of reservists can attain the objective of maintaining a balanced utilization.

This is a manpower situation the significance of which merits the attention of the petroleum industry—K. C. S.

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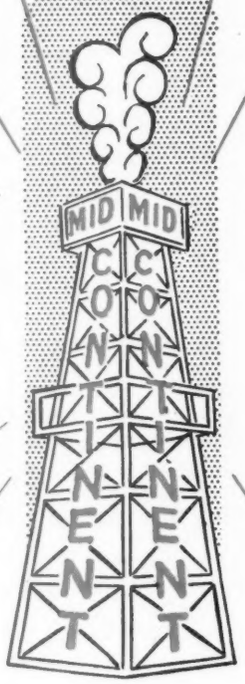

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Scanning WASHINGTON'S OIL HORIZON

Milburn Petty

WASHINGTON—Inequities resulting from the sudden "freeze" of oil prices have prompted Orville J. Judd (Ex-OPA), oil price director of the Economic Stabilization Administration, to seek a yardstick for testing the prevailing prices at all levels.

This involves an analysis of the price structure in each area to determine the "proper" relationship between the price of crude oil and refined products, and at the various levels of distribution, having in mind customary trade practices and historical differentials.

From this study, if Judd's idea is adopted, ESA would build an entire new oil price structure beginning with the price of crude in each area.

What would be the "proper" price for crude? Well, it should be a price that would assure a continuous supply to meet the requirements of both the civilian economy and national defense, Judd believes.

Since most crude prices have been stable at present levels or, in a few cases, climbing back toward old levels, the only room for adjustment is—upward.

▸ **Crude Prices.** ESA, in withdrawing its requested roll-back in California heavy crude prices, recognized that the 25-cent advance was needed to encourage the operation of marginal wells. Also, this advance was merely a step toward levels attained since the last war.

Similarly, in Michigan, crude buyers restored a 12-cent transportation differential which was absorbed beginning in June, 1949, to meet the competition of Illinois crude outside Michigan, a situation that no longer exists. Buyers voluntarily withdrew the new posting on the request of ESA, which promised prompt consideration of the matter.

▸ **PAD Consulted.** An encouraging sign has been ESA's readiness to consult with the Petroleum Administration for Defense and other interested agencies before acting on oil prices. For example, both PAD and the Navy advised against rolling back the California crude advance, pointing out that the state was supplying more than half of the military's oil requirements with but 16 per cent of the nation's oil production.

▸ **Tankers.** Tankers rates continued to rise, despite the oil price "freeze." Rates reached levels of 175 per cent above the USMC rates of the last year. This has squeezed East Coast marketers (and refiners, too, who sold on a delivered basis). ESA has indicated that it may make use of the rate-making machinery provided in the new "pool" being set up to supply the military's tanker requirements. Under the management of the Maritime Administration, the operators participating—voluntarily—will supply their pro rata share based on their proportionate share of the tonnage included.

▸ **Octane Cut.** The octane-ceiling order, proposed by PAD in Mid-January, will require only slight reductions for most refiners. It is not likely to be the last such cut. The military's aviation gasoline demands are rising, with larger jumps expected before the year is out. Meanwhile, PAD is faced with building up a stockpile of tetraethyl lead for avgas while still providing for a civilian gasoline demand increase, which the Bureau of Mines has estimated at nearly 10 per cent for 1951. Sun Oil Company, marketing one grade of gasoline for which it claims "premium" performance at the "regular" price, has protested the octane-ceiling.

▸ **Drilling Controls.** Following through with his policy of "the fewer controls, the better," PAD Deputy Administrator Bruce Brown wants to avoid the detailed regulation of well spacing and other production practices from Washington, as was done by PAW during the last war.

Brown wants the state oil regulatory agencies to do the job, encouraging the broader spacing of wells, for example, by granting larger allowables in such cases. The state agencies welcomed the idea and promised full co-operation.

But there are other federal agencies who believe that the use of materials should be controlled from here. As a compromise, PAD suggested that the *distribution* of materials be regulated by the petroleum administration, with well spacing and such left to the states.

▸ **Steel.** The idea now is that each operator would be required to submit his drilling program for the coming quarter, detailing his requirements of tubular goods. PAD would study each report and, if considered OK, the operator would be assigned a certificate number for insertion in his purchase order. PAD had hoped that this certificate business could be confined to the 5 per cent set-aside program for supplying emergency needs to complete wildcats or drill necessary offsets.

PAD has been working on a program, with the National Production Authority, under which the steel companies would be directed to make 1,890,000 tons of oil country tubular goods during 1951. (This would include 128,000 tons for foreign operations.) PAD Deputy Brown points out, however, that some steel men doubt that this record-high goal can be attained, particularly with other defense needs to be met. That is why Brown emphasizes every pound of steel available should be utilized to produce the maximum amount of oil and gas.

▸ **Imports.** With the total demand for all oils going above the 8,000,000 bbl a day mark for several weeks recently, and the Texas allowable increased to a near-record level, the criticism of imported oil has died down even though the million-barrel figure has been topped repeatedly. Even Congressman Patman (Texas), who last spring, was urging President Truman to limit imports now says it is "fortunate" that restrictions were not imposed.

▸ **Pipe Lines.** Flooded with proposals to build new pipe lines, particularly to the West Coast, PAD has launched a complete transportation study "from which it will be possible to determine what pipe lines are most essential to the domestic economy and national defense." PAD is helping speed construction of present projects by interceding, when requested, to break bottlenecks on deliveries of materials.

▸ **Benzene.** The NPA has decided that benzene from petroleum is the best way of meeting the increased requirements for this important chemical used in synthetic rubber, plastics, and other items used by the military. Facilities for making 88,000,000 gal annually from petroleum will be built. Projects for more than half of this quantity are now on file with the PAD, for which accelerated tax amortization is being sought.

▸ **Fuels Study.** All signs point to Senator O'Mahoney of Wyoming taking up the ball and running with it on the Myers Resolution for a study of all fuels, looking to the development of a national fuels policy. So, keep an eye on the Senate Interior Committee.

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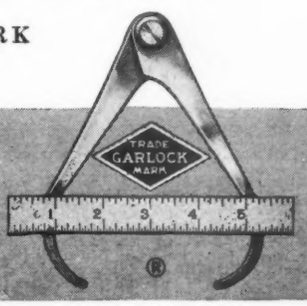

HIGHLIGHTS IN OILDOM

EXTENDS GAS EXPORT EMBARGO

Alberta, Canada has extended the embargo on gas export until September, 1951. Domestic needs estimated for the next 30 years total 4.5 trillion cubic feet, with present reserves estimated at 4.4 trillion cubic feet. It was agreed that export would be in the province's best interest when sufficient reserves are established.

ESA APPROVES PRICE RISE

The Economic Stabilization Agency has withdrawn the request that California oil companies roll back crude prices. Orville D. Judd, ESA oil consultant made this known, in a letter to several leading oil companies on the West Coast. No detailed reasons were given in the letter, but industry men believe it is to assure no cut back in production on the West Coast.

1950 OIL PRICE HIKE SMALL

Despite spiraling costs and other economic factors, the wholesale price index of crude petroleum and petroleum products advanced only one percentage point in 1950. This compares with 4.1 point increase in the index of wholesale prices for all commodities during the same period. The average retail price of motor fuel in 1950 declined slightly, while the average for local, state, and federal taxes on motor fuel advanced slightly. The average total cost per gallon to consumers was slightly under the 1949 post-war peak.

DEFERS CONSERVATION BILL

Until the present state of emergency ceases to exist the Oil Producers Agency of California will defer a request that the California State Legislature enact a bill providing for proper conservation of the state's oil and gas resources. This decision was reached and is in keeping with the request of Governor Earl Warren that legislation other than that directly related to the defense effort, or of a definitely emergency nature, be postponed until normal conditions have been reestablished. Although it is probable that some form of Federal regulation of production practices will be set up for the duration of the emergency, and thus to some extent assure partial accomplishment of the desired result, the Agency believes that the only ultimate solution of this matter lies in state conservation.

PEAK DEMAND SEEN IN 1951

Mounting civilian and military requirements will combine in 1951 to create the greatest demand in history for petroleum products is the opinion of most oil men today. A Chicago Journal of Commerce survey of leading petroleum economists disclosed an average estimate that demand for the 4 principal products in 1951 will reach a total of about 5.6 per cent larger than the total for 1950. They expect the largest gains to be supplied by distillate fuel—the average of their estimates for this product's gain being 8.2 per cent. The next gains are expected in kerosine, 7.9 per cent; gasoline, 7.2 per cent, and distillate demand for 1,187,000 bbl daily.

STEEL ALLOCATION SUFFICIENT

The oil industry will be allocated enough steel to drill 44,000 new wells in 1951, the Petroleum Administration for Defense has announced. An estimated 890,000 tons are needed. Last year 1,700,000 tons of tubular steel were used to drill about 43,000 wells. The 1,890,000 tons are expected to include 128,000 tons for use by American oil companies abroad.

TIDELANDS CONTROL BILL

New legislation has been introduced to the Senate to grant the government "emergency authority" to administer oil-rich tidelands under the marginal seas. "Petroleum," Chairman of the Interior Committee, Joseph O'Mahoney stated, "is one of the two basic strategic materials for both industry and war." The other is steel.

The new legislation would provide that oil and gas leases issued by the states prior to December 21, 1948, which were in effect June 5, 1950, may continue to be operated except that any would terminate within 5 years in the absence of production or drilling operations. It would also provide that bonuses, rents, royalties, and other funds payable in connection with all leases except those on disputed lands, go into the Federal Treasury — with the states receiving back 37.5 per cent from "all the receipts from areas within their seaward boundaries."

MEETINGS. New dates are set for Petroleum Industry Electrical Association, April 17-19, Adolphus Hotel, Dallas, Texas, and for Natural Gas Department of American Gas Association, May 7-8, Dallas, Texas.

OUTLOOK FOR SUPPLY IS GOOD

Spokesmen for the Independent Petroleum Association of America and the American Petroleum Institute believe the next year may bring new problems to the oil industry, but the present outlook is for adequate gasoline supplies for both military and civilian use. Barring unexpected developments, oil men believe the fuel oil supply for civilian use will be adequate for the rest of the winter. They expect an adequate steel supply for casing, pipe, and machinery, as the Petroleum Administration for Defense has obtained allocation of enough steel for 44,000,000 wells in 1951.

INCOME MUST EQUAL OUTGO

Earnings must be sufficient in the oil industry to cover the large risks inherent in this type business, is the opinion of S. A. Swensrud, Gulf Oil Company president. An oil company must find each year sufficient oil to replace that which is produced and it must find more oil than it produces in order to expand. Oil companies operating abroad have added risks of political and economic disturbances in the international field. Another risk grows out of the inflationary character of our present economy. High cost capital investments would prove decidedly unsound should a deflationary period develop. The weather embodies another risk. Varying weather affects the consumption to such an extent that there may be either an over-supply or a shortage.

INDUSTRY MUST REMAIN FREE

Two outstanding developments in 1950 will influence the oil industry in the years to come, Robert E. Wilson, chairman of the board, Standard Oil Company (Indiana) has stated. They are (1) the transition from a peacetime to wartime economy and return of governmental controls. War demands thus far have amounted to only about 4 per cent of total sales; however, Wilson stated it has "pinched in important places — particularly in high octane aviation gasolines and high quality lubricating oils." He stressed that the oil industry is in its present satisfactory condition as a "result of greatly enlarged productive capacity. It did this by heavy investment of plow-back earnings and borrowed capital in its period of freedom since World War II."

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UNITED STATES STEEL

National Petroleum Situation

By H. J. STRUTH*

1950 RECORD YEAR. The petroleum industry's ability to provide petroleum to meet the constantly expanding demand was again demonstrated by record-breaking performance. Exploratory effort surpassed that of any previous year, and increased the nation's petroleum liquids reserves to more than 30½ billion bbl, despite the production of over 2 billion bbl of oil. New peaks were established in demand for petroleum products, which were accompanied by greater supply availability, and new high records in refining operations.

YEAR'S FIGURES IMPRESSIVE. Demand for petroleum in 1950 aggregated 2,470,896,000 bbl, averaging 6,769,000 bbl daily. This compares with a daily average in 1949 of 6,119,000 bbl, and the previous peak recorded in 1948 of 6,143,000 bbl daily. Demand was nearly 11 per cent greater than in 1949, while the total supply of all oils was only slightly less. Stocks of all oils were reduced only 5,000,000 bbl during the year. Demand for motor fuel increased about 7 per cent, while the use of light and heavy fuel oils was 12 per cent greater than in 1949. The industry drilled 42,084 wells in 1950, compared with 38,885 wells in 1949. Wildcat well completions rose to a new high record of 8064 compared with 6872 wildcats drilled in 1949. Preliminary studies credit 1950 with the discovery of more than 4 billion barrels of new reserves, nearly as much oil was discovered in the peak year of 1937.

IMPORTS SHARPLY HIGHER. Preliminary data indicates the total volume of petroleum imports during 1950 at 313,537,000 bbl, against 234,131,000 bbl in 1949, representing an increase of 34 per cent. Crude oil imports increased 11½ per cent in 1950, while imports of refined products rose about 73 per cent. Refined products imports exceeded 135 million bbl against 79 million bbl in 1949. Residual fuel oil imports accounted for 66 per cent of the increase over 1949.

PEAK REFINING OPERATIONS. Refinery runs to stills in 1950 rose to a new peak of 2,094,230,000 bbl, which comprised an increase over 1949 of about 8 per cent. Crude oil production in the United States amounted to 1,971,921,000 bbl, an increase of 7 per cent over 1949, but represented a decline from the peak of 2,020,000,000 bbl established in the year 1948. Production of all petroleum liquids in 1950 was about 2,150,000,000 bbl.

Petroleum Consultant, Dallas, Texas.

Comparative Statistics, December, 1950

*All figures are computed on a Bureau of Mines' Basis**

	Dec. 1950Ⓟ	Nov. 1950Ⓡ	Dec. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Total supply,* all oils	227,257	220,357	196,148	2,465,827	2,230,830	+11
Daily average	7,331	7,345	6,327	6,756	6,112	
Total demand,‡, all oils	232,076	215,237	215,375	2,470,896	2,233,604	+11
Daily average	7,486	7,174	6,948	6,770	6,119	
Change in stocks	—4,819	+5,120	—19,227	—5,069	—2,774	
Crude supply*	194,750	189,935	170,795	2,149,813	1,995,229	+ 8
Daily average	6,282	6,331	5,510	5,890	5,466	
Crude demand‡	194,090	188,519	173,449	2,154,669	1,998,500	+ 8
Daily average	6,261	6,283	5,595	5,903	5,475	
Crude stocks	248,500	247,840	253,356	248,500	253,356	— 2
Days supply	40	39	45	40	45	
Natural gasoline production	16,500	15,715	14,681	180,199	156,203	+15
Daily average	532	523	474	494	428	
Motor fuel production	90,100	87,300	83,515	1,023,501	961,791	+ 6
Daily average	2,906	2,910	2,694	2,804	2,635	
Gasoline yield, per cent	41.3	41.7	43.4	43.2	44.3	— 1.1
Motor fuel demand‡	84,180	82,901	77,334	1,017,678	952,356	+ 7
Daily average	2,715	2,763	2,495	2,788	2,609	
Motor fuel stocks	116,500	110,580	110,495	116,500	110,495	+ 5
Days supply	43	40	44	43	44	
Fuel oil production	81,000	73,700	69,283	822,944	764,359	+ 8
Daily average	2,613	2,457	2,235	2,255	2,094	
Fuel oil demand‡	107,340	97,861	97,875	981,954	848,181	+12
Daily average	3,463	3,262	3,157	2,690	2,324	
Fuel oil stocks	118,200	122,440	135,400	118,200	135,400	—13
Days supply	34	38	43	34	43	
Refinery still runs	188,500	183,850	169,723	2,094,230	1,945,519	+ 8
Daily average	6,081	6,128	5,475	5,738	5,330	
Stocks, all oil	597,900	602,869	602,969	597,900	602,969	— 1
Days supply	80	84	87	80	87	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62
Texas	2.61	Arkansas	2.43
California	2.42	New Mexico	2.40
Oklahoma	2.62	Mississippi	2.23
Kansas	2.62	Illinois	2.76
		Other states	2.60

Basic crude prices:

Oklahoma-Kansas (36 gr.)	$2.57
Texas Gulf Coast (36 gr.)	2.80
East Texas	2.65
West Texas (36 gr.)	2.44
California Signal Hill (26 gr.)	2.31
Pennsylvania, Bradford	4.25

Drilling and Production Statistics

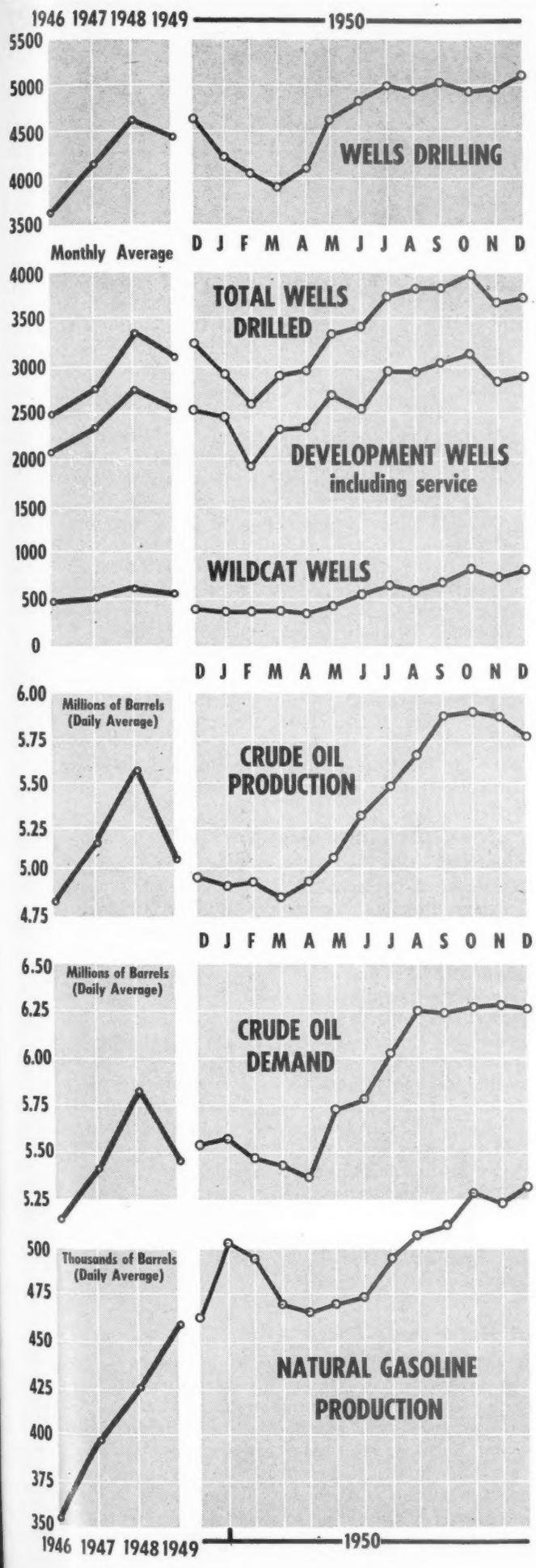
	Dec. 1950Ⓟ	Nov. 1950Ⓡ	Dec. 1949	This Year to dateⓅ	Last Year to date	Per cent change
Wells drilling	5,070	4,950	4,915	5,070	4,915	+ 3
Total wells drilled	3,701	3,693	3,450	42,804	38,885	+10
Development wells	2,895	2,872	2,761	33,908	30,829	+10
Oil	1,982	1,880	1,847	22,806	20,697	+10
Gas	227	214	243	2,684	2,776	— 3
Dry	686	778	671	8,418	7,446	+13
Per cent dry	23.7	27.1	24.3	24.8	24.2	+ 0.6
Service wells	51	78	109	832	1,184	—30
Wildcat wells	755	743	580	8,064	6,872	+17
Oil	115	102	84	1,225	1,113	+10
Gas	17	17	13	233	203	+15
Dry	623	624	483	6,606	5,556	+19
Per cent dry	82.5	84.0	83.5	81.9	80.8	+ 1.1

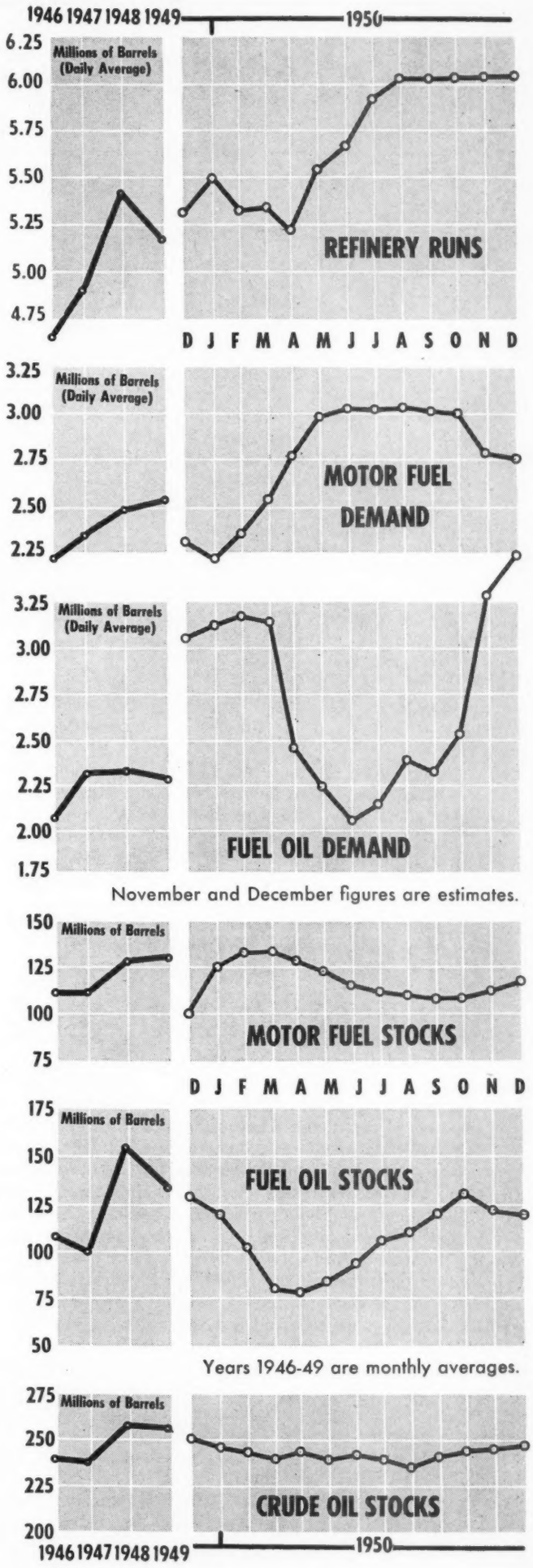
By State

Wells drilled (excl service)	3,650	3,615	3,341	42,172	37,701	+12
Arkansas	33	39	20	395	327	+21
California	166	151	174	2,050	2,510	—18
Illinois	220	269	256	2,916	2,648	+10
Kansas	362	336	330	3,818	3,348	+14
Louisiana	219	196	244	2,458	2,400	+ 2
Mississippi	13	19	23	299	332	—10
New Mexico	41	59	37	607	483	+26
Oklahoma	487	470	413	5,369	4,291	+25
Texas	1,519	1,416	1,261	16,587	13,930	+19
Other states	590	660	583	7,673	7,432	+ 3
Wildcats drilled	755	743	580	8,064	6,872	+17
Arkansas	7	9	8	104	72	+44
California	42	37	25	439	465	— 6
Illinois	45	67	54	668	535	+25
Kansas	96	59	61	806	533	+51
Louisiana	31	27	20	292	306	— 5
Mississippi	6	10	9	131	111	+18
New Mexico	11	4	5	83	78	+ 6
Oklahoma	58	72	75	847	797	+ 6
Texas	359	343	248	3,406	2,978	+14
Other states	100	115	75	1,288	997	+29
Daily crude production	5,766	5,844	5,024	5,403	5,042	+ 7
Arkansas	85	85	85	86	82	+ 5
California	971	959	868	899	912	— 1
Illinois	170	164	177	170	177	— 4
Kansas	303	309	280	295	279	+ 6
Louisiana	610	604	551	572	495	+16
Mississippi	103	108	98	105	104	+ 1
New Mexico	133	147	131	132	131	+ 1
Oklahoma	500	495	426	452	416	+ 9
Texas	2,454	2,555	2,020	2,269	2,038	+11
Wyoming	187	179	137	166	129	+29
Other states	250	239	251	257	279	— 8

* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. • Includes domestic production and imports. Ⓟ Preliminary. Ⓡ Revised.

Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.




1946 1947 1948 1949
1950
Millions of Barrels (Daily Average)
REFINERY RUNS
D J F M A M J J A S O N D
MOTOR FUEL DEMAND
FUEL OIL DEMAND
MOTOR FUEL STOCKS
FUEL OIL STOCKS
CRUDE OIL STOCKS

November and December figures are estimates.

Years 1946-49 are monthly averages.

PETROLIC PERSONALITIES

DICK SNEDDON

Another Domino Aspiration Scuttled

In partnership with Fritz Ripley, the Ideco delegate from Torrance, California, we recently did further battle in the Los Angeles Petroleum Club's current domino tournament (consolation section) with Paul Terry, the Capital Company's leading tile tosser and his aid, Sam Grinsfelder, Union Oil Company vice president and a pretty swell citizen to boot. This fantastic embroglio featured some of the fastest scoring we have seen in many a long day. Pegs of 8 and 9 occurred with distressing regularity, and after a futile effort to ward off catastrophe our side was forced to abandon ship and take to the life boats. This humiliating rout strengthens a growing conviction that we just don't have the mental or physical accoutrement of a domino player. Our pegging is neat but altogether too infrequent and although there are other aspects of the game in which we do rather well, in the main we are quite lacking in the killer instinct, which is the real mark of the hotshot performer.

Restraint is the Soul of Etiquette

Up to the moment we have failed to win a single match in any tournament and our children are in consequence the laughing stock of the neighborhood. Personally, we don't mind the ignominy of the thing, but we hate through association to expose a nice fellow like Fritz Ripley to the danger of social ostracism. However, we are bound to confess that this latest bit of embarrassment was administered in a very gentlemanly way. What we mean is that when Paul and Sam streaked out ahead of us at the critical stages of the critical games, they were gracious enough not to make slighting references to our ineptitude. All they did was to jump up and down, slap each other on the back, and laugh unrestrainedly.

A Name Like a Golf Foursome

It was our pleasure to chat with H. S. M. Burns, president of Shell Oil Company, up at Emeryville a short time ago, and we found him a completely personable, easily approachable individual, who is intensely interested in the complex world petroleum situation, and tremendously fond of the people who make up the petroleum industry. During a short talk, which he had delivered a few minutes before, in which he had expressed genuine excitement over the accomplishments of Shell's research subsidiary, Shell Development, and had disclosed some of the company's plans for the immediate future, we detected a faint trace of that Caledonian burr that all the travel in the world can never quite buff off the Gaelic tongue. Later along with a group of visiting newsmen we received a dissertation on plaids and tartans that further emphasized the Scottish origin of the speaker. In appearance there is nothing to differentiate him from a typical American, however—he is a tall, husky, pleasant looking chap, obviously in the prime of health. He has a generous thatch of blond, wavy hair, and a full name like a golf foursome on the St. Nicholas links. It is Hendry Stuart McKenzie Burns — but in the interest of economy he usually signs himself "H. S. M." and his friends have tagged him with a cryptic "Max," a distinctly un-Caledonian nickname.

From Gravity Observer to President

Mr. Burns was born in Aberdeen, Scotland, early enough to do a stint as a second looie in World War I. When that adventure was concluded, he matriculated at the University of Aberdeen in the arts, but as his real interest crystallized, he switched to geology and chemistry, and finally graduated in the sciences. A short time after his graduation he took part in a 5-day competitive examination and won the Ferguson scholarship to Cambridge University. Just subsequent to his entry there he was transferred to Clare College — a historically famous institution — whence he emerged with a master's degree in mathematics and physics. It was while still at Cambridge that he decided to make petroleum his life work and to seek his opening opportunity in California. He came to California and began as a gravity observer in Shell's exploration and production department; a year later he was transferred to marketing, and following a decade of intense experience on the west coast, was sent to London, England. Thence he moved with his family to Venezuela as second in charge of Shell's interests there; then to Colombia where he spent another ten years setting up an organization and directing exploration and production activities. It was during his tenure there, incidentally, that the Casabe field was discovered. In 1946 he was returned to the United States as senior vice president of the company and the next year was elected to the presidency.

Extra-Curricular Occupation

In addition to his company responsibilities, Mr. Burns is a director of the American Petroleum Institute and is active on three directors' committees—public relations, research, and safety. He is also a member of the New York Racquet and Tennis Club and the Pacific Union Club of San Francisco, and he is one of the best executive golfers in the industry. He has played to a four handicap in his time and still shoots consistently in the low eighties. Whenever a promising subject presents, he shoots expertly, too, with a 16 mm movie camera, and high in his rating of really worthwhile subjects are Mrs. Burns, the former Miss Dorcas Jackson of San Francisco, and their two sons, Peter and Michael. Mr. Burns is, indeed, a man of many interests and capacities. His love of human society is obvious in his every gesture and there is nothing casual about either his contacts or his conversations. In all he does there is power and drive—even when he defines plaids and tartans—and it is easy to understand why he should now be directing the destinies of one of the world's most outstanding examples of free enterprise.

Artist Heads Local AAODC

Just elected to the top spot in the California chapter of the American Association of Oilwell Drilling Contractors is that colorful habituee of the petrolic byways, Alexander Hamilton Bell who has been a power in the drilling end of the business for a good many years. "Ham," as he is familiarly known to practically every oil man on the west coast, was born in Alameda, California, and in his younger days came mighty close to deserting the material path of the artisan for the more ethereal route of the true artist. His

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initial training was as a mechanical engineer but his family was keen to make a Rembrandt, a Gainsborough, or a Whistler out of him and he was consequently enrolled as a student at the Mark Hopkins Art Institute. In 1906, however, he slipped his moorings there and took a job with Union Oil Company in the Bay area, but his father was so eager to have him continue his art studies and so disappointed by this development that out of sympathy young Ham compromised and permitted himself to be apprenticed to an architect.

A Side Trip Into Architecture

Thereafter he carried out various architectural assignments in Chicago, New York, and San Francisco, in fact, in the latter place he was responsible for the interior detail of the first Grauman theater and, indeed, one of the first big-time movie theaters to be built anywhere. Ham continued in this type of work until the end of the first world war when he accepted a job to design a camp for Tide Water Associated at Avon. From camp structure he stepped up to refinery design engineering and in a comparatively short time was appointed refinery engineer. After a siege of this he was moved to Bakersfield as field engineer and later did some moving on his own account, first, to Bartlesville, Oklahoma, and then to Tampico, Mexico. In 1926 he was with Marland Oil Company back in San Francisco and when Seal Beach came in he was moved south as general superintendent of Continental Oil Company, successor to Marland. He has been a drilling contractor since 1947 when he and his partner, Dewey Burden, took over Continental's drilling department, all its drilling equipment, and over a hundred employees. Ham's recent appointment is well earned. He knows the drilling business in all its phases from alpha to alfalfa and he is a fearless campaigner for what he believes to be in the best interest of the industry. Despite the ponderosity of the drilling operation, however, he has never lost the light touch that distinguishes the true artist.

Kirkuk Polo

Also had a recent communique from A. F. "Hoopie" Driskill over in Kirkuk with the Iraq Petroleum Company. Hoopie is drilling superintendent over there and is well and favorably known to every equipment man and oil emissary who ever journeys into that part of the world. He was here, partly on business and partly on pleasure not long ago and when we last talked with him was just about to return, via London, England, to Iraq. This quiet mannered, gentlemanly Texan had his origin in Spanish Fort, and did his first oil work in the Healdton field in Oklahoma in 1913. Before he was fully organized the big war broke out and he was into it. On his release from the service he acquired further drilling experience around Burkburnett, Mexia, and Ranger, Texas, and Duncan, Oklahoma, and then moved to Calinia where with the Gettys, George F. and Paul, and Standard of California he greatly extended his understanding of drilling and production techniques.

He went to Iraq for what was then the Turkish Petroleum Company in 1927 and some years later was elevated to the position of drilling superintendent. In the meantime he has gained the reputation among Americans visiting in Iraq of being both an accomplished, well informed operator, and a gracious host. In his leisure moments Hoopie plays golf and polo, which latter we understand is simply golf with horses, and sometimes wanders off with congenial company on a hunting expedition. He tells us that hunting is excellent in Iraq and especially recommends such zoological types as the black partridge, gazelle, wild hog, and a mountain bird similar to the pheasant, known locally as the *chikor*. The only mountain bird we are familiar with over here is one who borrows our rifle occasionally and packs into the High Sierras. So far as we know the only thing he ever bagged was his pants, but that, of course, has nothing to do with the subject, so without further delay for 1951 we wish good health, good hunting, good company and all they would wish themselves to the Driskills and their daughter Phyllis over yonder in Kirkuk.

Last Minute Roundup

From Al Gregersen in Copenhagen came a note a few days ago expressing the hope that 1951 may bring to the world a little more happiness and greater promise of peace and quiet. Al is directing the affairs of the Danish American Exploration Company and he tells us that they are now getting under full scale operation after being partially shut down for about two years, pending renegotiation of the original concession. He sends his best to the home folks. Also a card from Olivia and Walt De Castro with whom we were associated many years ago in Union Oil Company. Walt is now located in San Jose, Costa Rica, and appears to be enjoying life to the full in the lively South American republic. Last but by no means least, a cheering message from Dick Guiberson, one of our favorite people, that transformed a threatening storm into a refreshing shower.

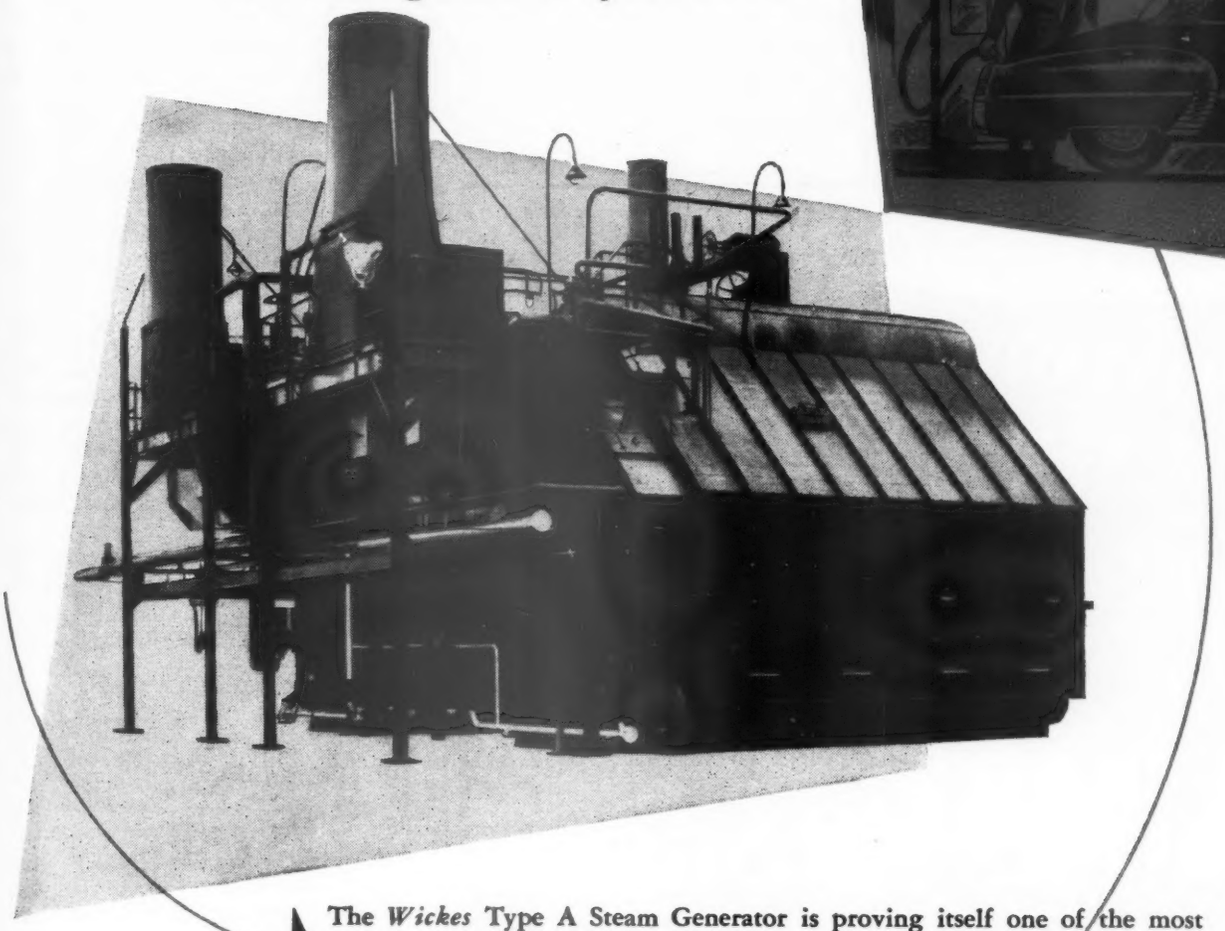
We had a note some time ago from Paul Lehr, the ex-Hoosier, who is with Shell Caribbean Petroleum Company in Maracaibo, Venezuela. Paul was born in Indianapolis, auto racing center in the state whence come most our literati, but at the age of 12 he turned west and headed straight for Maricopa, California.

With his family he lived on the old General Petroleum pump station at Pentland, the which we have visited many a time in our early pipe line days. Here he studied such Valley fauna as centipedes, scorpions, and tarantula, and learned to sing the children to sleep with that popular lullaby:

A tarantula jumped on a
centipede's back
And shouted with ghoulish
glee,
"I'll puncture this poisonous
son of a gun
Before he punctures me."

WICKES STEAM GENERATORS

at work in new Texas natural gasoline plant . . .



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LETTERS *to the* EDITORS

Heat Transfer

To The Petroleum Engineer:

This is in reference to your letter of July 24, 1950 concerning a question raised by Mr. D. J. Bergman* of Universal Oil Products Company about my article on "Cylindrical Furnaces."

I am in complete agreement with Mr. Bergman's comment that radiant heat transfer is a function of the difference in the fourth power of the radiating and absorbing surface temperatures. Unfortunately the phraseology of my paper is somewhat confusing on this point. However, in any event the basic idea expressed in the paper is still true since each tube receives a quantity of heat which is in direct proportion to the oil temperature of that tube. Certainly it is true that for those furnaces wherein the overall difference between inlet and outlet oil temperatures is small, that the difference in heat transfer is also small. However, in writing this paper I had in mind perhaps a more common case such as a crude preheating heater where the overall temperature difference between inlet and outlet tubes is in the order of 300-400 F. Trial calculations will readily indicate for this case that the difference in rate of heat transfer may amount to between 10-20 per cent. This is of appreciable magnitude and well worth considering the basic design of tube pattern and coil layout.

Another factor, which perhaps has not always been taken into consideration, is that the temperature drop through tube walls becomes progressively greater as the oil temperature rises. This fact then also tends to increase the difference in rate of heat transfer between hotter and colder tubes.

I trust that these comments will satisfactorily answer Mr. Bergman's question.

O. F. Campbell

Sinclair Refining Company
East Chicago, Indiana

* Published in *The Petroleum Engineer*, September, 1950, page A-22.

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API Committee

To the Petroleum Engineer:

I was very much pleased to read and I want to express to you the thanks of myself and my API Committee on your splendid article in the November issue of The Petroleum Engineer. (Page D-3)

I was at the Los Angeles annual meeting and held a meeting of our Committee for the purpose of discussing a repetition of last year's St. Louis conference in 1951. Much favorable comment was made of your article.

John W. de Groot

President,
Tuscarora Oil Company, Ltd.
Harrisburg, Pennsylvania

Bouquet

To The Petroleum Engineer:

I have certainly enjoyed The Petroleum Engineer and have gleaned much knowledge from its well edited pages for many years; and I wish you continued success in your field of endeavor.

Clark H. Shaw

P 902.113.

THE Petroleum Engineer

FEBRUARY, 1951
Volume 23
No. 2

Export Markets for Alberta's Gas

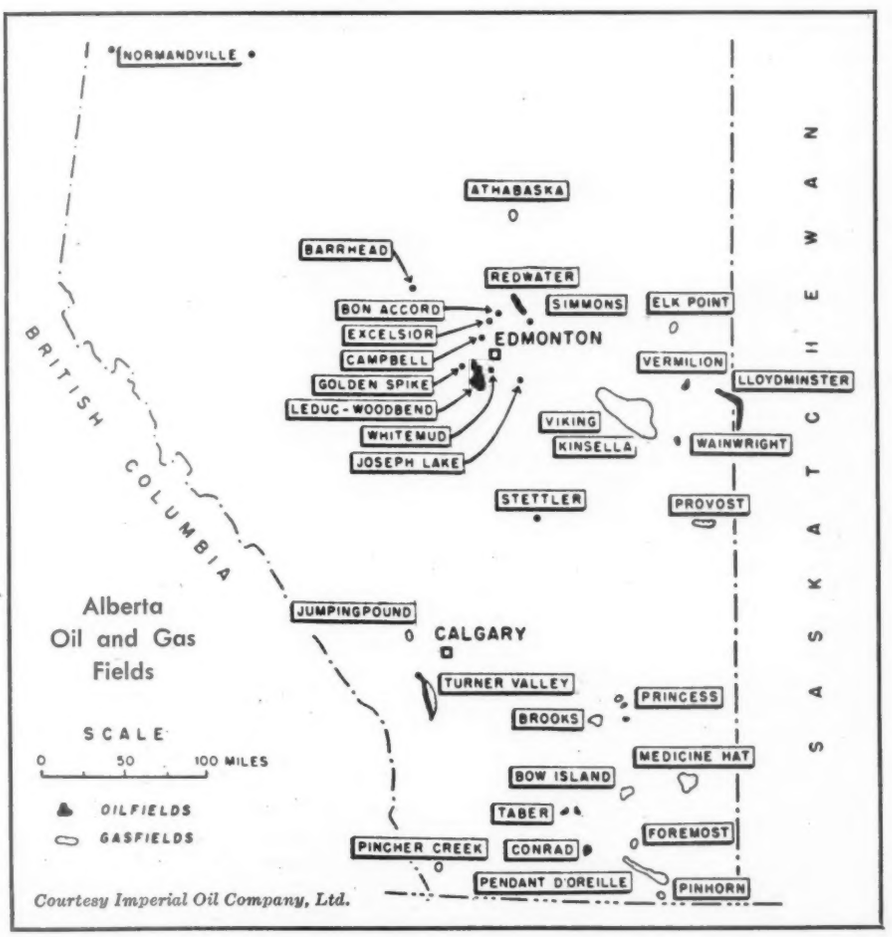
Canada faces economic problems of estimating its new natural gas reserves and determining the best areas for distribution.

H. G. COCHRANE

CANADA has long been the world's leading exporter of hard wheat. For 30 years she has been the world's largest exporter of base metals. She is the second largest producer of aluminum. Sixty per cent of the world's newsprint is of Canadian origin. But only during the past 4 years has Canada appeared as one of the world's potential leaders in the production of petroleum.

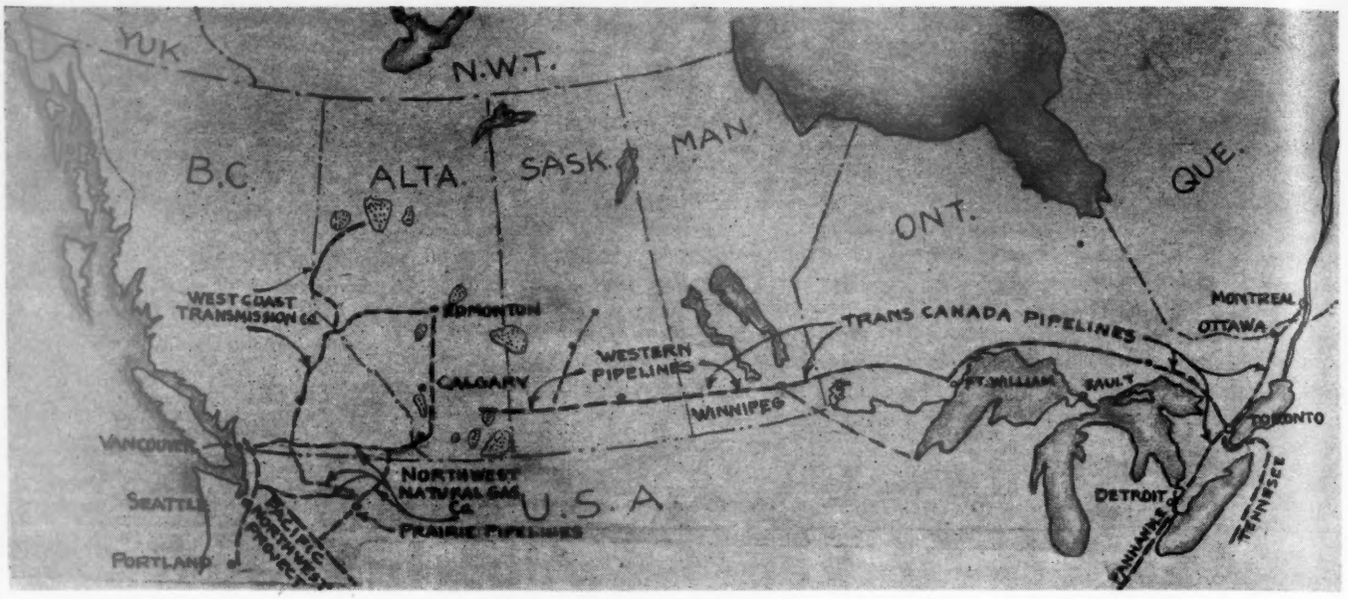
Alberta's oil boom, which started early in 1947, has so far proved up reserves of about 1½ billion barrels of oil. If the ratio of natural gas reserves to oil reserves follow the pattern of petroleum fields in the United States, this means some 7½ trillion feet of natural gas as well. Actually this is only slightly higher than the estimate made by Dr. George Hume, head of Canada's Geological Survey, of 7 trillion feet as of 8 months ago.

These current discoveries and development of oil and natural gas in Alberta are of prime importance to a country that has been until recently an importer of between 85 and 90 per cent of its petroleum needs and that today imports nearly 60 per cent of its coal. In this dangerous age, they are of vital strategic importance



Courtesy Imperial Oil Company, Ltd.

EXCLUSIVE



Proposed natural gas pipe lines from Alberta to Canadian and U. S. markets.

in terms of the defense of the American continent.

They are of great significance too, for a people living in a northern climate, where dwellings require to be heated almost half way round the calendar. Canadian coal resources, though vast, occur mostly in the far west and the far east. The heavily industrialized central provinces have to depend on coal imports from the United States.

Oil has been rapidly replacing coal for heating in all provinces since the end of World War II, particularly in British Columbia and the central provinces, and is fast taking the place of coal for railway locomotives. But only in the province of Alberta, and in a small section of Western Ontario, has heating so far been done by natural gas to any extent. Southern Alberta cities have had natural gas for heating for 40 years. Edmonton, the capital, has had it for 25 years. Sudden spells of "40 deg below" weather may have curtailed the supply, due to moisture in the gas condensing and reducing the pipe diameter, just at the time furnaces were turned on full. But that was a small price to pay for its comfort, convenience, and cleanliness.

The city of Vancouver, certain cities in the Pacific northwest states, the other two Canadian prairie provinces, and areas in the central provinces around Toronto, Ottawa, and Montreal, have all been eyeing this new source of cheap fuel, wondering how long it would be till they too could discard coal shovels and ash cans and let their thermostat turn on the gas.

Alberta citizens, watching Texas producers (Pacific Northwest Pipe lines) laying plans to pipe Texas gas 2200 miles from Houston to Seattle and Portland and thus snatch away their closest mass market from under their noses, are somewhat impatient at their provincial Government's reluctance to permit any export of gas outside of the province. If a decision is delayed much longer the chance may be gone. To reach another market of comparable size the gas might have to be piped 3 times the distance, perhaps a fourth of it across the rugged Precambrian rocks north of Lakes Superior and Huron.

History of Natural Gas in Canada

Gas was first discovered in Western Ontario in 1888, and was exported to supply Buffalo and Detroit in the "Nineties." Ontario pioneered in using abandoned fields for gas storage. In 1915 the first successful experiment in storage of gas below ground was carried out in Welland County. But today these fields are pretty well depleted, and the supply has to be augmented from across the border.

The first Alberta gas was found in 1884 at Alderson. In 1890 more was found around Medicine Hat. In 1909 gas from the Bow Island field was piped to Lethbridge and Calgary, but as the supply began to peter out in the late twenties, gas from Turner Valley, most of which was then being wasted in flares, took over the load, using abandoned Bow Island wells as a storage reservoir. Edmonton got its first gas from the Viking field in 1923, later in 1940 the Kinsella area was developed as a peak load field.

Today Northwestern Utilities supplies a population of 150,000 (37,000) customers in the Edmonton area from the Viking and Kinsella fields east of the city, with 15 billion feet of gas yearly. Canadian Western Natural Gas Company supplies a population of 150,000 (38,000 customers) in Calgary, Lethbridge, and adjacent towns with some 21 billion feet of gas yearly, mostly from Turner Valley, are now laying pipe from the Jumping Pound field. The Medicine Hat area consumes about 4 billion feet a year. Gas consumption has increased five fold in Edmonton and more than doubled in Calgary over the last decade. Prices to the small domestic customer range between 17 and 30 cents per thousand feet, about equivalent in heating value to a large sack of coal or 6 gallons of medium diesel fuel oil.

In Calgary, experts have calculated that in 1948, heating with fuel oil was about 3 times as expensive as heating with gas. Heating with coal, they claimed, was about 9 times as expensive as with gas. Added to this are the relative advantages in favor of gas over coal such as cleanliness, continuity of supply, saving of delivery and handling charges, no storage, and lower equipment repair and maintenance costs. Natural gas is generally found to sell for half the price of manufactured gas, provided distances for transportation on the former are not unduly high.

The situation with respect to heating by natural gas in Canada is different from that in the United States in this respect: In the U. S., gas re-

serves in Texas and Oklahoma were already proved up through oil discoveries long before long distance pipe lines reached a high degree of efficiency in the late twenties. It was not until recurring strikes of coal miners and sharply higher wages in the "forties" forced the price of coal up and made supplies uncertain that natural gas, under regulatory restraint, came into wide popularity for space heating. By the time Canadian gas reserves began to be assured, on the other hand, higher prices and recurring threats of scarcity of coal had already created a demand for other fuels, and techniques of gas transmission had already reached a high degree of perfection.

This difference is in some measure responsible for Alberta's tardiness in reaching a decision with regard to export. Gas is a provincially owned resource, and the Alberta government feels it must first be sure reserves are adequate for growing domestic consumption, with enough surplus left over for outsiders, before the province can permit exports beyond its boundaries.

Natural Gas Commission Report

Following upon applications from promoters for permits to export gas, first presented 3 years ago, a three-man commission was set up late in 1948 to inquire into reserves and consumption of natural gas within the province. At the time reserves were assessed at 4½ trillion feet, of which 3½ trillion were recoverable. Expert witnesses testified as to probable rate of future discoveries. Forecasts ranged from "9 to 10 trillion feet further over the next 10 years", to a "total of 15 trillion feet by 1953 with an ultimate total of 50 trillion feet." Dr. George Hume of the Geological Survey believes potential reserves could be many times the amount now proved and probable, though no quantitative estimate could be supported.

Withdrawals for domestic use, the Commission found, at the 1948 rate of 37 billion feet yearly and with the probable rate of increase, would require double the reserve at that time, or 8½ trillion feet, over the next 50 years. At the 1948 annual consumption rate of 37 billion feet yearly, the ratio of reserves to withdrawals was 4 times better than the ratio for Texas, and twice as good as for Louisiana and Oklahoma. They implied a considerably lower ratio would be safe, and observed that so long as additions to reserves exceeded withdrawals so the trend was upward or constant, the reserve situation would be healthy.

They considered additions to reserves resulting from oil discoveries would maintain a safe ratio under present conditions if waste were avoided. They observed export was needed as an incentive to increase reserves to support such export. But the question as to whether export was itself in the public interest was not within their terms of reference and no opinion was offered.

The Commission members were fully in accord with the principle of local priority in the matter of gas supply, and beyond that limit they approved of priority to Canadian consumers. They favored the pooling of reserves by means of a grid system connecting the various fields, rather than unilateral contracts between exporters and producers, or the idea of earmarking of certain fields for local markets, leaving exporters to take what they could get elsewhere. "Gas cap" gas, the members felt, should be kept off the market so long as it was aiding in the recovery of oil.

Reading between the lines of their report, it would seem the Commission held the view that the province should market its natural gas through export when and where it could, leaving advances in the processes for coal gasification, applied to its vast coal reserves, to take care of the future, taking over the load with cheap manufactured gas through the same distribution systems if and when natural gas became depleted.

Export Projects

Three new pipe line companies received letters patent permitting them to incorporate during the 1949 session of Canada's Parliament. North-

Constructing a gas pipe line like the ones that will be needed to carry Canadian gas to market.

—Courtesy Tennessee Gas Transmission Company

west Natural Gas seeks to serve the Pacific coast market with some 60 billion feet yearly. Alternate lines are projected, via Spokane to serve Portland and Seattle and Vancouver, and an all Canadian line via Trail, B. C. to serve Vancouver first, then Pacific coast cities.

Westcoast Transmission proposes a line of similar capacity through the Yellowhead Pass to Kamloops and down the Fraser river to Vancouver, thence to Seattle and Portland. Both these pipes would be roughly 1000 miles in length. Gas would be purchased at Wellhead for 10 cents per thousand feet, and sold to distributors at around 38/40 cents; to consumers at perhaps 60/70 cents.

Western Pipelines are prepared to market 26 billion feet yearly via an 800-mile line to Winnipeg, and other towns and cities along the route, with a branch to Saskatoon and Prince Albert, and with a possible extension to Duluth. Gas would sell to distributors at around 30 cents per thousand feet, and to consumers at from 39 to 64 cents depending on volumes used.

Also seeking incorporation at the next session of Canada's Parliament are: (1) Prairie Pipelines, which would build a pipe from the Pincher Creek field to tie in with the proposed Pacific Northwest pipeline from Houston to Seattle, now awaiting approval from the U. S. Federal Power Commission. The input of gas from Alberta would roughly equal Vancouver's demand, about equal to Alberta's present domestic consumption and more when available. (2) Trans-Canada Pipelines, sponsored by Canadian Delhi Corporation, which is applying for permit to serve Winnipeg, Toronto, Ottawa, Montreal, many other cities and communities en route, and with branches to Sault Ste. Marie and Ottawa. Input of gas would be over 3 times present Alberta domestic consumption. Possible prices at Toronto to distributors might be 40 cents in Toronto, and 45 cents in Montreal. Gas must sell to consumers at under 55 cents to meet competition from other fuels. (3) There are also various combined schemes currently being studied between Pacific Northwest, Prairie Pipelines, a Toronto group under the name of Eastern Gas Syndicate, and Panhandle Eastern; by which import-export saw-offs would be arranged; the West Coast getting Alberta gas while the Canadian Central Provinces would get an equivalent volume of Texas gas.

Economic Aspects

The Alberta Government first approached the problem of export with the idea that domestic consumption should be assured of its needs for 50 years ahead. Today they feel if they protect the home market for the next 25 or 30 years, the future will take care of itself. Reserves now are probably more than sufficient for the home market over this shorter period. Thus there should soon be a visible surplus for the neighboring Prairie provinces. Approval of this much export should act as a spur to further gas discoveries.

On the other hand, there is something to be said for the idea of a tie in with the Texas producers' Pacific Northwest project, thus getting a share at least of the Pacific coast market. It is doubtful whether the Pacific coast cities will want to wait until Alberta reserves are sufficient to fully support the 60 billion feet yearly that this market requires. As for the Trans-Canada Pipeline project to serve Eastern Canada, though promoters behind it are now drilling for gas, and finding it, there is a wide gap between present reserves and the requirements for this, the largest and most ambitious project of them all.

It has been pointed out that nobody in the Federal Government at Ottawa is taking much interest in bringing the gas to the Central provinces. Toronto has a deal pending with Tennessee gas transmission for Texas gas, now awaiting Federal Power Commission and Transport Commission approval. If this gets the green light it would keep Alberta gas out of Eastern Canada for at least 20 years, since Trans-Canada needs the Toronto market, plus the old Essex County abandoned field for storage, to make their project economically feasible.

Defense Aspects

The use of natural gas could help continental defense in several ways. Used in domestic heating it could conserve coal for industrial uses and the fueling of vessels in wartime. It could reduce the rail transportation needed for hauling coal. It could provide cheap and convenient fuel for industries. Defense authorities in Washington want natural gas for their atomic energy plants in the states of Washington and Idaho. On their behalf, Ottawa authorities have been urging the Alberta government to make up their minds promptly about exporting their gas. Alberta sources are half the distance away from these plants as are Texas services, so Alberta gas,—if there is enough—will be cheaper and will take less scarce steel for pipe lines.

But in the end it may be this very question of steel supply that determines what area, if any, gets Alberta gas. Without details regarding the design of the lines, steel requirements can be only guessed. Yet even assuming the lightest weights of pipe, the Pacific Northwest project would require at least half a million tons. Trans-Canada would require almost as much, which is a sixth roughly of Canada's yearly steel consumption or half of her yearly steel imports. Various lines from Alberta to the west coast call for 150,000 to 175,000 tons, excluding gathering grid. Even Western Pipelines, the shortest alternative, would need 125,000 tons. Though steel for gas lines occupied near top position on the civilian priorities schedule during the last war, it seems rather doubtful, as long as the present tense international situation remains, that Canada's steel control would release such large tonnages for what might be termed luxury use today.

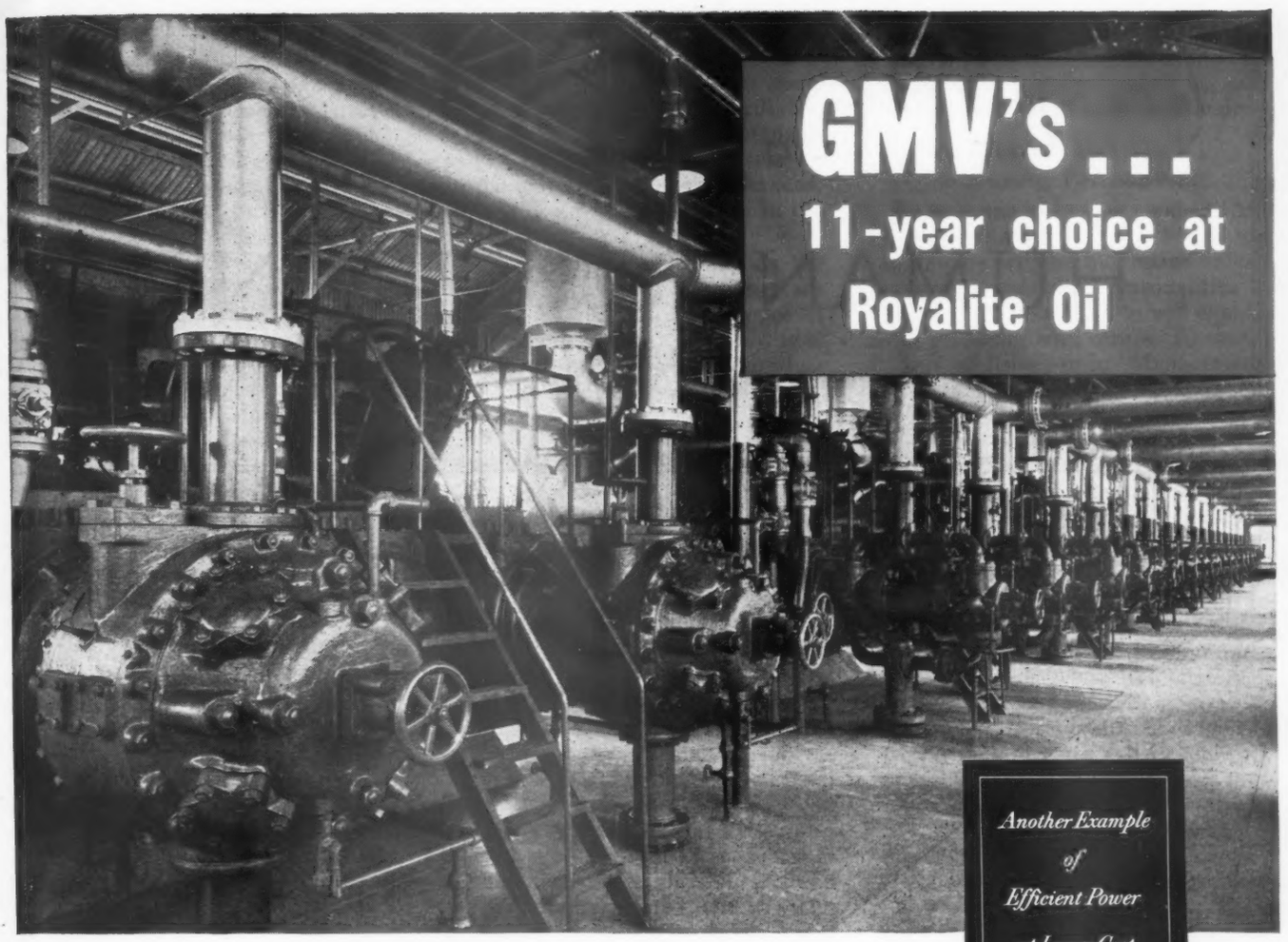
Decision on Export May Come Soon

Hearings have been going on in Calgary the past 3 months before the Petroleum and Natural Gas Exploration Board, in an attempt to arrive at a decision on the province's exportable reserves, leaving individual applications for specific export routes aside for the present. There is a growing belief that when an announcement comes, it will be to the effect that certain fields will be set aside to protect domestic requirements for the next 25 or 30 years, possibly some 5 trillion cubic feet. After that any area outside Alberta may have to take its chances on what is left, or find additional reserves and prove to the Transport Board that they were large enough to justify their project.

The Canadian Parliament spent almost 2 weeks during its 1950 session discussing oil and gas. Their "Pipeline Act", passed in 1949, placed responsibility for the approval of pipe lines crossing provincial or international boundaries in the hands of the Board of Transport Commissioners. To do this, the Board would have to study markets, sources of supply, the price structures, and the economics of the lines to be followed. This will take time.

So, in spite of the desire of many areas outside Alberta to have the comfort and conveniences of gas heating, and in spite of the $35 to $40 millions yearly of U. S. funds that could be saved in the central provinces on imports of American coal, it seems probable that considerable time will elapse before natural gas will be piped across Alberta's borders.

* * *



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In the Natural Gas—
Natural Gasoline Industry

HUMAN RELATIONS*

H. L. EGGLESTON†

WHEN one attempts an analysis of human relations in an industry such as the natural gas-natural gasoline industry, he is impressed with the magnitude of the task. Well qualified specialists have spent years in a critical examination of many phases of the subject. The literature abounds with impressive works that effectively treat of specific cases, or that pave the way for an understanding of the basic, underlying elements that govern many human relations situations.

Time does not permit us today to undertake a comprehensive review nor to examine intensively the entire field. I have chosen to treat of the common denominator that pervades all human relations situations, for there *is* such a common denominator. It is relatively simple; it is practical. If we develop skills in its use and apply them effectively, we'll progress far in the improvement of our human relations.

Where do we now stand? What kind of soil must we cultivate? Are human relations good or bad with us? In the natural gas and gasoline industry, we are exceptionally fortunate in many respects. We do not need to be told that our environment is ideal and we know that (1) the intelligence level of our people is high, (2) the management of our companies is alert, well informed, competent, (3) our economic structure is favorable, (4) employment has been and is likely to remain relatively stable, (5) we have in the California Natural Gasoline Association an ideal medium for the improvement of many procedures and many relationships, not the least of which is our relationship to one another. For over the last twenty-five years we have progressed. Our human relations are good. However, we've reached no millenium. We can go much further. Today we're concerned with the "how." Let's then look first at the nature of our relation one to the other.

We, in this Association, are individual members — individuals related to other individuals. As individuals we operate in groups. Small groups, larger groups, combinations of groups that make up our companies. As individuals we also work in many locations and environments and on different occupational levels. But regardless of group or location or environment or level we, as individuals, are related to other individuals in our environment and outside. We are also as individuals related to many group functions. Man to man, man to boss, man to his unit (his plant, his laboratory, his gang) and man to his company. Or, more simply, man to man and man to group function.

Every human relations situation, wherever encountered, is individualistic in concept. Two or more human beings related to each other in an environment. Human relations must be treated on the individual basis and on the group or function basis.

In this area there is a manufacturing organization that makes a product we use. They had excellent human relations within the company for many years. But shortly before World War II, due to conditions we can understand, they were required to deal with outsiders purporting to represent certain of their employees. Human relations deteriorated. Came the time, after the war, when a revision was demanded and the company found it could no longer tolerate the unfair tactics of those leaders who did not justly represent the views of their men. They broke with those leaders—were faced with a strike, and had to sweat it out for a period of months. But now, two years later, the relationship between all individuals in the organization, from top to bottom, is fine. The vice president of that company told me recently that his guiding policy was to be fair to the interests of every individual employee. He said, "We are firm but we are fair. We try to understand the viewpoint of every man and we are loyal to his interests. We know that they understand the functions, needs, and objectives of the company and the viewpoints of those who run it and that they too are loyal and fair. We have a warm personal contact with every man in the organization."

That, then, is the first step — a warm, personal, friendly understanding relationship among *all* individuals. All human relations are personal. If good, they are warm, friendly, understanding.

Some one will say, "That's all right for a small company but it won't work in a large group." But it will—if it's permitted to work or encouraged. In this audience today are several men who are employed by a large company that has had many human relations problems in the past. But the group in which these men operate is led by one of our members, who has fostered in his group a warm, personal, friendly, understanding contact among all his men. Their human relations quotient is high, in spite of handicaps imposed by the relatively poor over-all position of the company at large. The men in this group work in complete harmony because they understand each other.

And understanding is a two-way responsibility. Understanding by each individual of the needs, interests, functions, and viewpoints of the others he deals with. And in any organization, small or large, complete understanding must be fostered and achieved on the individual level and on the group level. The men who

*Based on an address given before the annual meeting of the California Natural Gasoline Association, Ambassador Hotel, Los Angeles, California, November 10, 1950.

†H. L. Eggleston has had years of experience in oil company operations and is now a consultant in industrial relations. He is a recognized authority in the important field of human relations.

speak for mangement must not only understand and treat fairly the interests and viewpoints of those not ordinarily a part of management but they must verbalize and foster understanding of the functions, objectives, and requirements of the company and of the units of which it is composed.

Our contacts with other individuals are for the most part verbal, but oral or written our communications must convey understanding. Let me quote from St. Paul's first message to the Corinthians: "Therefore, if I know not the meaning of the Voice, I shall be unto him that speaketh a barbarian." I would paraphrase that this way: "When I speak or write to you, I must make the meaning of my words so unmistakably clear that you cannot fail to understand." And *you* must be sure that you understand the meaning of the words I use. A two-way responsibility to achieve understanding. And we must use *words* to do it.

Semantics

Let's look, then, at the $64 word "semantics," which has been made to seem complex but which in reality should not be at all confusing. Semantics is simply "the science of the meaning of words." We here, of course, are dealing with semantics as a linguistic tool to improve our skill in achieving understanding; for if we are skillful in the choice of the words or word structures we use, we'll become more adept in enabling others to understand us. You can make Joe angry or pleased, resentful or cooperative by the choice of the words you use in talking with him. And, Joe's background and his viewpoints are important because words mean different things to different people, at different times, in different places. But far more important is the necessity for discrimination in the use of definitive "labels." Joe may be capable but you don't like him. If you show your resentment by condemning him with a "label" when you talk with others you'll destroy his usefulness to you and the company.

We have, say, in our organization a very brilliant, very capable man. He is well trained and in some respects is a genius in devising new procedures of great value to the company. He thinks ahead, is resourceful. But sometimes he irritates people. He's not always skillful in his use of words. And some monkey in the outfit perhaps intolerant, resentful, or insecure — but certainly lacking in semantic skill—pins a label on that man by saying to others, "He's impossible, *no one* can get along with him—he's crazy." And that label, in time, creates misunderstanding, it comes to identify the man as a liability when in fact his talent is an asset. So he's sidetracked and his skill, his brilliance is lost to the company when all that's needed is a sincere effort to understand, a little tolerance, and a little judgment and skill in the use of words.

Many years ago I worked as the foreman of a small absorption plant under a man adept in the practice of good human relations. I was hot tempered, intolerant, as was the production foreman in that area. We were hardly on speaking terms, did not work well together and the company suffered. One day both of us were called in to the field headquarters by our boss who said, "I like both of you boys. You are both of great value to the company. But you don't get along well together. We are going to straigthen out your differences before we leave this room." Turning to me he said, "Herb, what's your story; why won't you get along with Art?" I pinned the blame on Art, and he in turn blamed me. Finally the boss said, "I understand your troubles, and I know how silly your resentments are. And I also know how fine your relationships can be if both of you try to understand each other and cooperate to set a good example for the rest of the organization. Forget your differences, shake hands, and work together." We did—and out of that understanding grew a relationship that was of benefit to each of us and to the company. All because a man skilled in human relations taught two soreheads how to behave.

To me, the best understanding of semantics, restricted for the moment to the linguistic field, can be gained by a study of two books by Bess Sondel—"Are You Telling Them"[1] and "Effective Speech."[2] Her observations are profound and for those who as laymen would like to understand more about the comprehensive field of general semantics and do not have the time nor the preparation to appreciate the great value of Korzybski's extensive treatment, a review of Sondel and a study of a third—S. I. Hayakawa's "Language in Action,"[3] will help greatly.

Two recent articles in Fortune demonstrate the importance of clearcut communication and point out the real danger of insincerity. "Is Anybody Listening?" in the September, 1950 issue and "The Language of Business" in the November, 1950 issue. The concluding paragraph of the latter article is significant. It says: "If we make a *real* effort to win mutual understanding, we need have no fear of the infinite variety of our language, or the ability of our listeners to respond to it. When business men have something to say, and mean it, and feel it, their audience will understand."

Improving Personality

So we come to human conduct, for we realize that all the fancy words we can employ will be ineffective unless we have in our own personalities a balance of those traits that will enable us to get along with others. To me—F. J. Roethlisberger in "Management and Morale"[4] points the way when he says, "In handling human relations logic alone will not avail. A human problem to be brought to a human solution requires human data and human tools. Collaboration is more a matter of sentiment than of logic." So—we are dealing with sentiments, emotions, feelings? Let's look.

Bess Sondel in "Are You Telling Them?" says "Life is a fusion of thinking, feeling, acting. We think, we feel, we act — that's all." Only when *all three* of these components are well developed and well balanced in a human being do we have a person skilled in achieving good human relations. Leave out any one, and the personality suffers. And so often, today, particularly at higher levels do we find a lack of the warmth (call it what you will — sentiment, emotion, feeling, dionysian component) that is so necessary in our relations with others.

What procedure *is* available now to an alert individual for self-improvement in personality? What can Joe do to help himself? I can speak with authority about one possibility. " I vas dere Sharley." I've seen over 50 individuals from many walks of life improve their human relations quotient phenomenally in a relatively short period of time. They've been led to a real understanding of their relationship to others and have been taught what to do about it. They've released. for effective use, abilities they never knew they had. The cost and the rigor of full participation is sufficiently high to discourage many but those who go through benefit greatly. Human relations instruction *is* available to those who want to grow.

Significant also is the fact that this type of instruction has been adapted for use by many large industrial organizations for training their key men. This is certainly a step in the right direction and the practice should be encouraged. Such instruction, properly designed to fit the needs of specific groups in our industry, would be most effective in promoting good human relations.

Many times recently I've heard the

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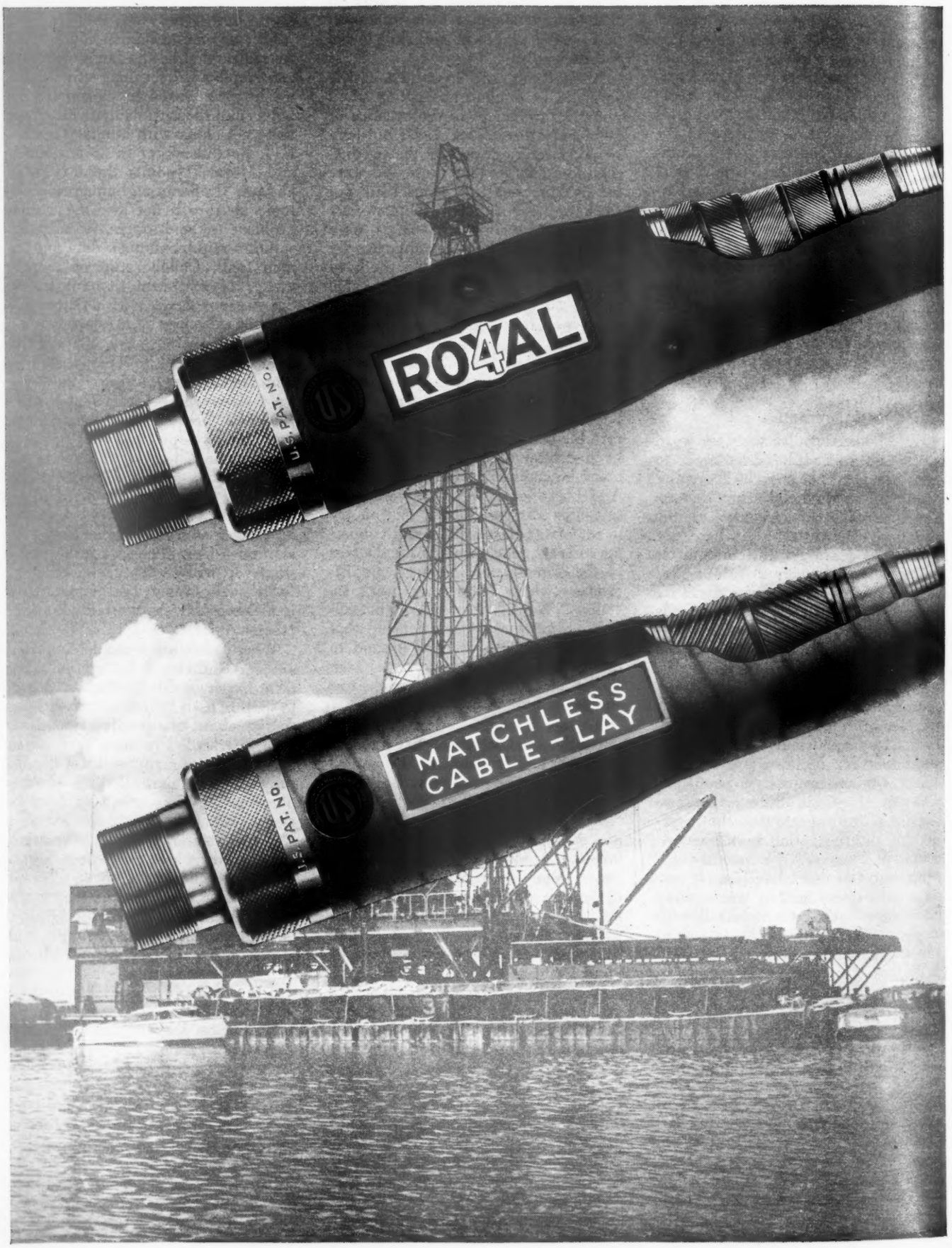

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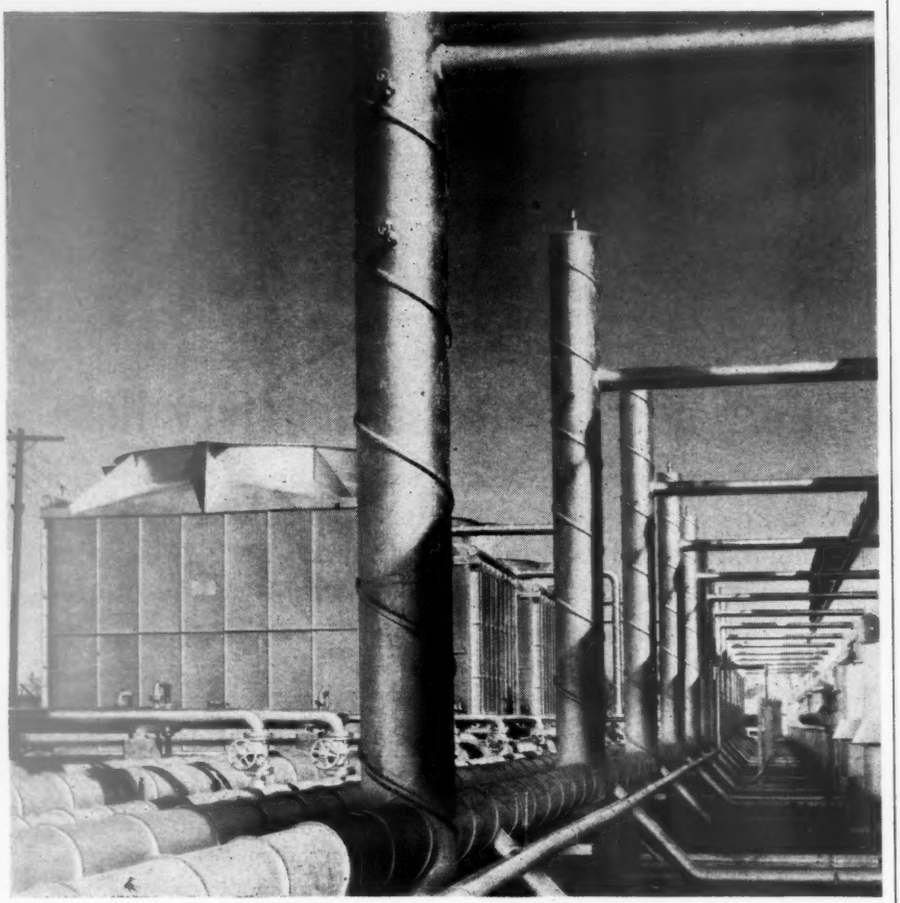

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comment voiced by leaders in our industry and in others that the thing we need is a "spiritual renaissance" and I agree. But this is a vague generalization that is hard to pin down. A man's religion is, to him, a private, personal matter. Hard to talk about. Something apart from his daily living. Many men deny interest but deep down in each of us there is an inner conviction or urge or principle or "feeling" that influences greatly our daily conduct—the way we live. Why not admit honestly that it's there? That it's a dominant influence, practical for everyday use, that it's YOU, that you're proud of it. For, down through the years from ancient times have come perfectly valid precepts for right living — for good human relations. Different perhaps to different people but all possessing a central core that is consistently uniform no matter what creed or belief a man may profess. And that central core is *loyalty*.

I've said that "there is a common denominator that pervades all human relations situations." Let us then sum up by reviewing the elements of which it is composed. We've seen that:

1. Human relations is individualistic in concept.
2. Relativistic in that each individual is related to other individuals and to group functions.
3. Understanding is a must. Understanding of the needs, viewpoints, and interests of the individuals we are related to and of the objective, functions, and requirements of the groups of which we are a part.
4. We must develop skill in communication.
5. We must develop in our own personalities, uniformly and effectively, the three character components of thinking, feeling, and action.
6. We must serve effectively and loyally the interests of the individuals and the groups to whom and to which we are related.
7. We must fire our service with an enthusiasm, with a zeal, that will bring out the best that's in the individuals who make up our team.

We, as individuals in this Association, have a surpassing opportunity. For if we will build such a concept into our souls and live it and feel it, we'll do more than build good human relations — we'll forge a magnificent pattern—and we'll make our world a finer place in which to live.

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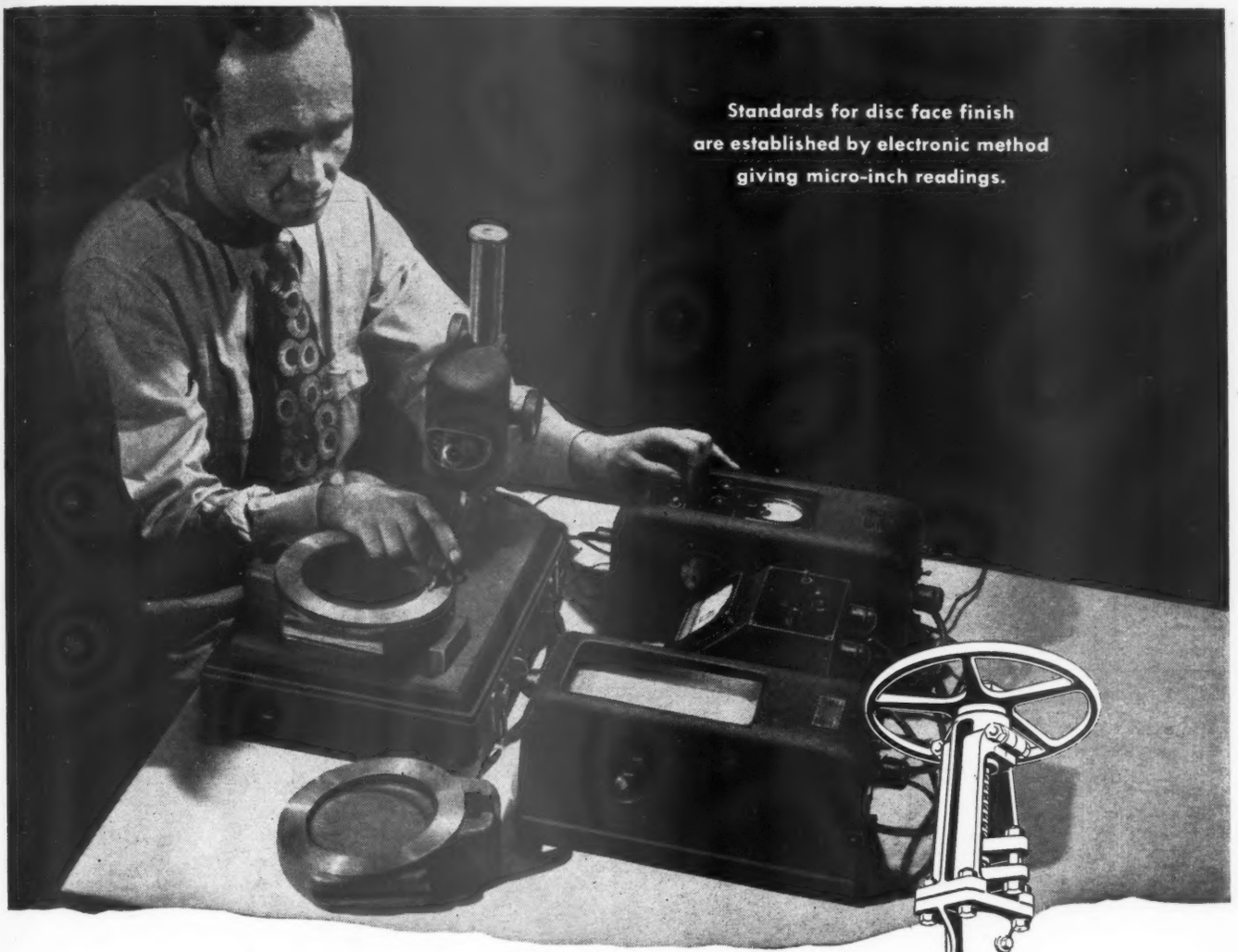

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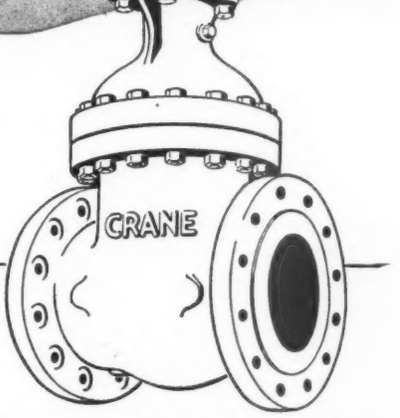

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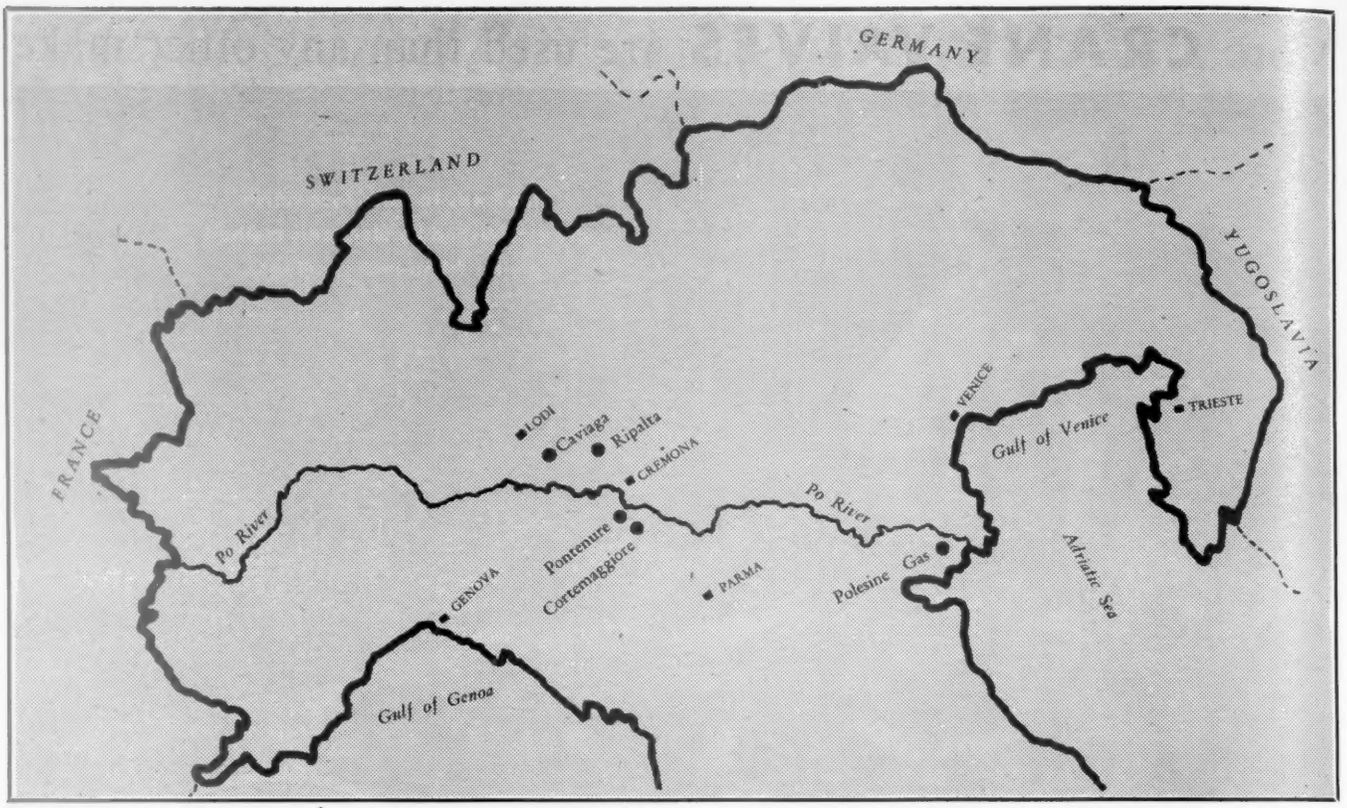

FIG. 1. Map of North Italy showing four established structures (Caviaga, Cortemaggiore, Ripalta, and Soresina).

OIL AND GAS IN ITALY

The valley of the Po reveals a thick sedimentary basin that has in recent years produced much needed fuel in the north.

THIS is a general review of the progresses made in Italy during the last few years. With pre-war and war equipment, mostly of German and Italian origin, and new post war American rigs, the AGIP (Azienda Generale Italiana Petroli), a 100 per cent Government-owned company, tested several structures located by seismic work.

Four structures were tested, and in each case, the first well drilled was a producer. In fact, out of the last 60 wells drilled since the war, only 4 or 5 have been dry or lost. All the others except 2 oil wells are gas producers.

The 4 established structures are in the Pô valley some 50 to 100 miles southeast of Milano (see Fig. 1).

Caviaga

The first one discovered is Caviaga (see Fig 1). It is an anticline structure situated some 6 miles southeast of Lodi. Caviaga No. 1 was drilled in 1947, to a total depth of around 5000 ft and the well produces on a ¼ in. choke about 500,000 cu ft of gas per day.

Since then 18 wells have been drilled (see Fig. 2). On February 20, 1949, while drilling well No. 13 at a depth of around 4800 ft, in the Messinian sands of the Miocene, the well blew out and caved in swallowing the whole rig. Gas then began to seep to the surface all around the well and an enormous amount of sand was blown out. Finally, the ground began to sink causing damages to the village of Caviaga, which had to be evacuated.

Soon No. 14, which was being completed, began blowing wild but was brought more or less under control. A third well No. 11, which was on production, began producing a large amount of gas between tubing and casing. It is still producing in this manner. After more than a month of battling with 3 wells, with No. 13 acting as a safety valve, everything quieted down. It is probable that through a leak in the casing of No. 11 or a faulty cementation of well No. 14, gas escaped from the lower sand into the near surface fresh water sands, causing the blowout of No. 13.

Today 10 wells are on production as follows:

Well No.	Choke	Daily production Million cu ft	Total production up Jan. 1, 1950 Million cu ft
1	¼ in.	½	320
2	⅛ in.	1	380
5	¼ in.	2	800
7	5/16 in.	3.2	480
8	5/16 in.	3.6	440
11	Between casing and tubing	12	1.800
12	1/5 in.	1.8	280
15	3/16 in.	1.6	....
16	5/16 in.	4	....
17	5/16 in.	4	....

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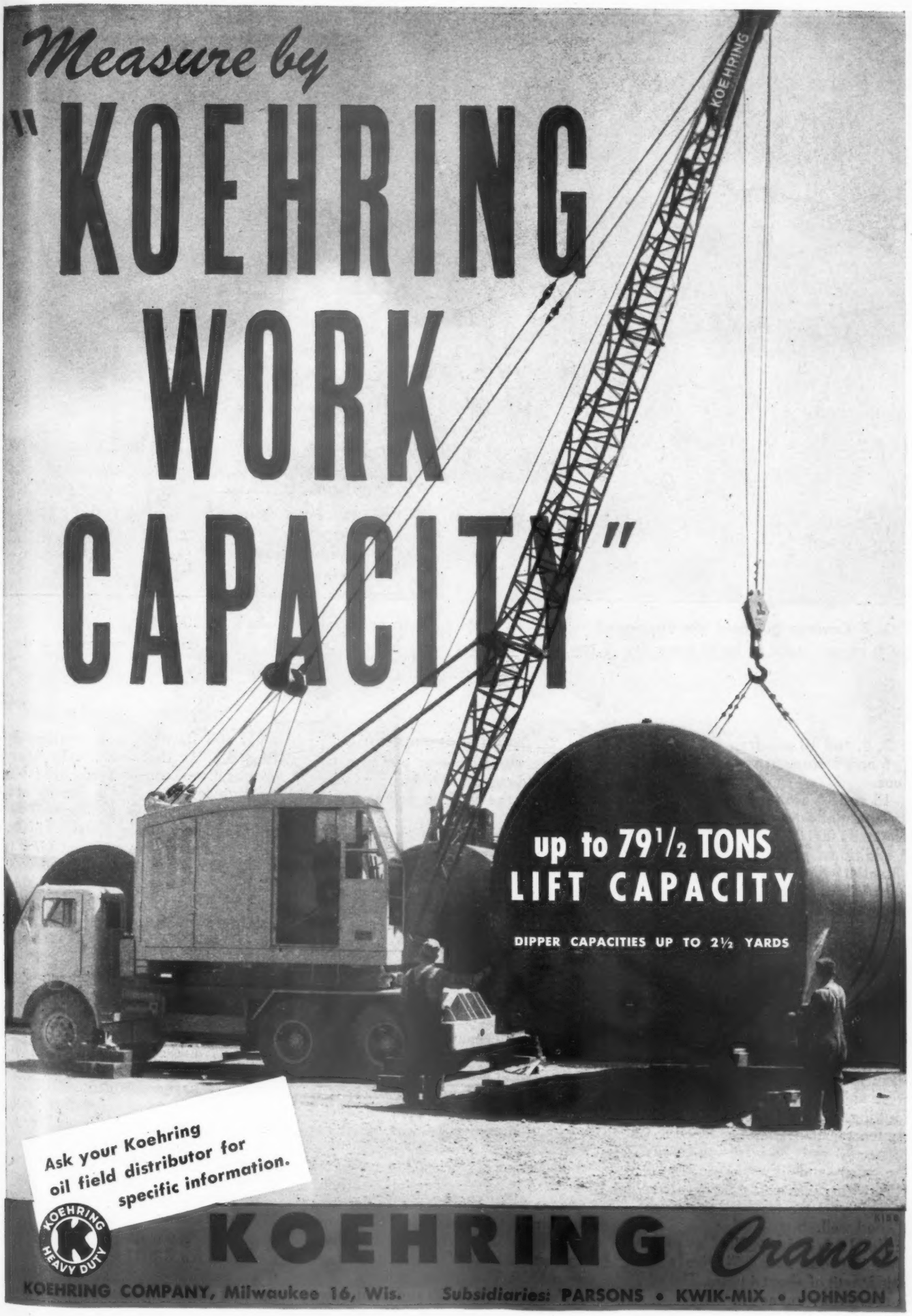

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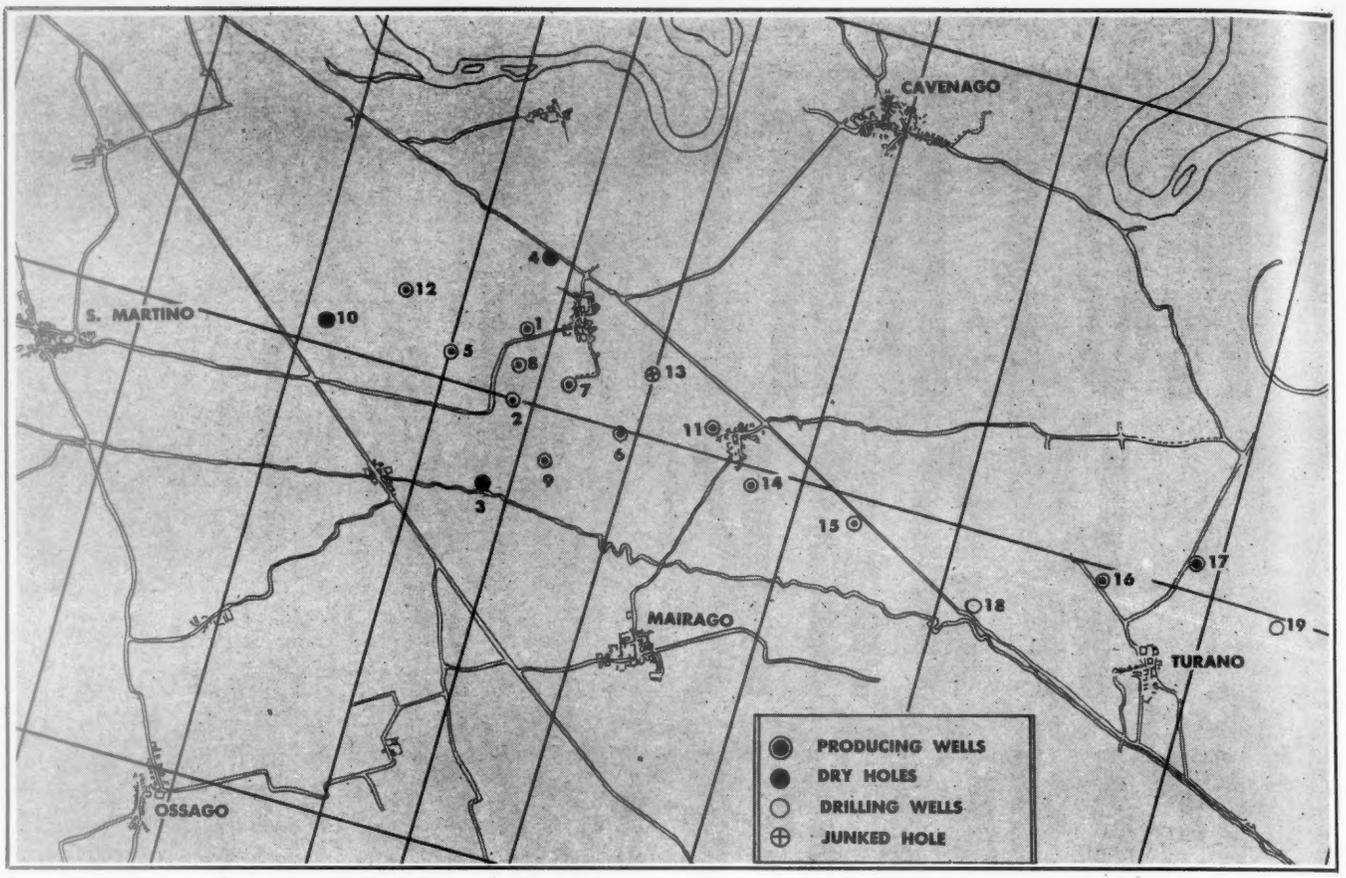


FIG. 2. Caviaga gas field was discovered in 1947 and now 10 wells are producing about 34,000,000 cu ft of gas daily, 3 holes were dry, 2 are shut in, and 2 were junked. One well gives 3 bbl of condensate a day.

3, 4, and 10 are dry.

6 and 9 are shut in for safety reasons.

13 and 14 are junked.

Total daily production is therefore about 34,000,000 cu ft of gas; with 3 additional producers completed the potential will be up to 45,000,000 cu ft.

In addition the gas is wet up to 24 per cent by volume, of condensate. The heaviest gas producer No. 11 gives 3 bbl of condensate daily and up to January 1, 1950, a total of around 1500 bbl of condensate have been produced.

Productive Acreage

Three dry wells, Nos. 10, 3, and 4 seem to define the field limit on the west side, although the presence of faulting may be responsible for dry compartments. After the blowing out of No. 13 and the intrusion of gas in the upper sands it was decided to drill No. 16 at a safe distance (about 3 miles) from the troubled region. It is a good well.

No. 19 is being drilled at present, and, if productive, will give a total field length of about 4 miles. The width is completely unknown.

Cortemaggiore

The general location of Cortemaggiore field can be found in Fig. 1 and details of the drilling are shown in Fig. 3.

Cortemaggiore is another anticline structure situated some 25 miles southeast of Caviaga in the triangle Piacenza-Cremona-Parma. Its main axis is nearly east-west and the seismograph indicates a structure of at least 5 miles in length or larger than Caviaga.

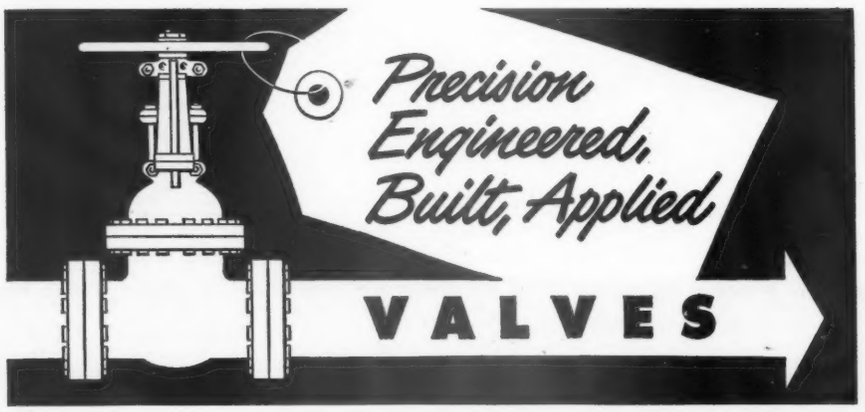
No. 1 Cortemaggiore was drilled in December 1948/January 1949 down to a depth of 5340 ft and encountered the same miocene sands (Messinian) already productive in Caviaga. The first gas sand is encountered at around 5000 ft and is about 50 ft thick. It is followed by some 150 ft of shale with few sand streaks. The next 140 ft are mostly sand with streak of shale. The whole section is gas bearing except the last 10 to 15 ft, which are oil saturated.

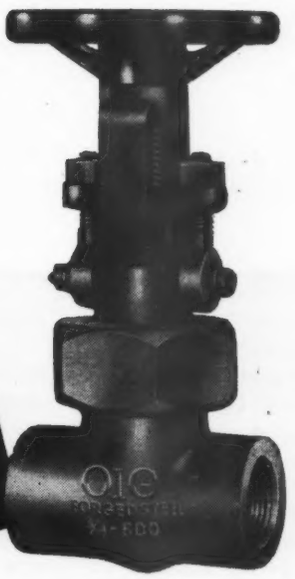
Since early 1950 Santa Fe Drilling Company of Los Angeles, California is drilling in Cortemaggiore under contract with AGIP, using one heavy Ideco 1350. They began drilling No. 6 on February 14, 1950 and went down to 11,400 ft, which was reached by June 15. At that time, very heavy pressure was encountered. Mud was built up for 8 days to a density of 2 (17.5 lb per gal) but still the well was not completely under control. Finally, the core barrel was hung at 6800 ft and a back-off operation freed 6600 ft of pipe. It was cemented and sidetracked at that depth. Then it was redrilled to 11,203 ft and casing was set in early November for extensive testing.

This well, the first deep hole drilled in Italy, revealed that a very thick sedimentary basin exists in the Pô Valley. At 11,400 ft it is still in the sandstone and limestone of the Tortonian (Miocene). No mechanical cores were taken down to 7000 ft and only a small number below that depth. Electrical logging and side wall coring was used extensively. A number of producing horizons (mostly gas sands) have been found. They alternate with salt water sands in a typical Miocene fashion.

Another interesting well is Cortemaggiore No. 18. Total depth of 5430 ft was reached by October 3, 1950 and the well was being tested when it blew

ANY VALVING REQUIREMENT





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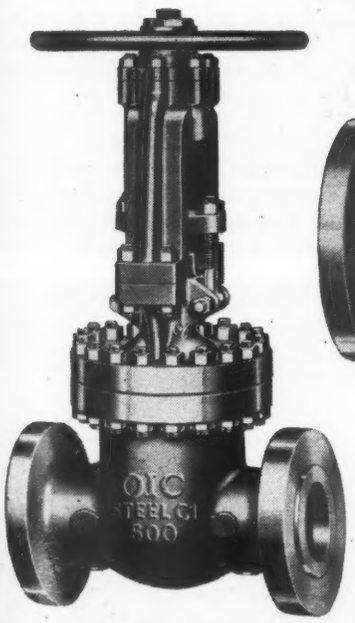

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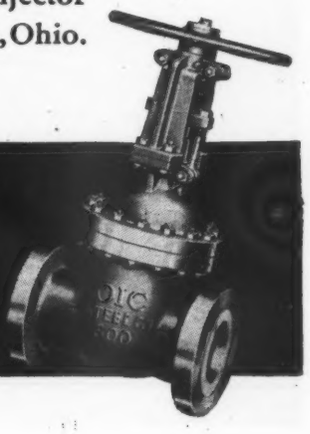

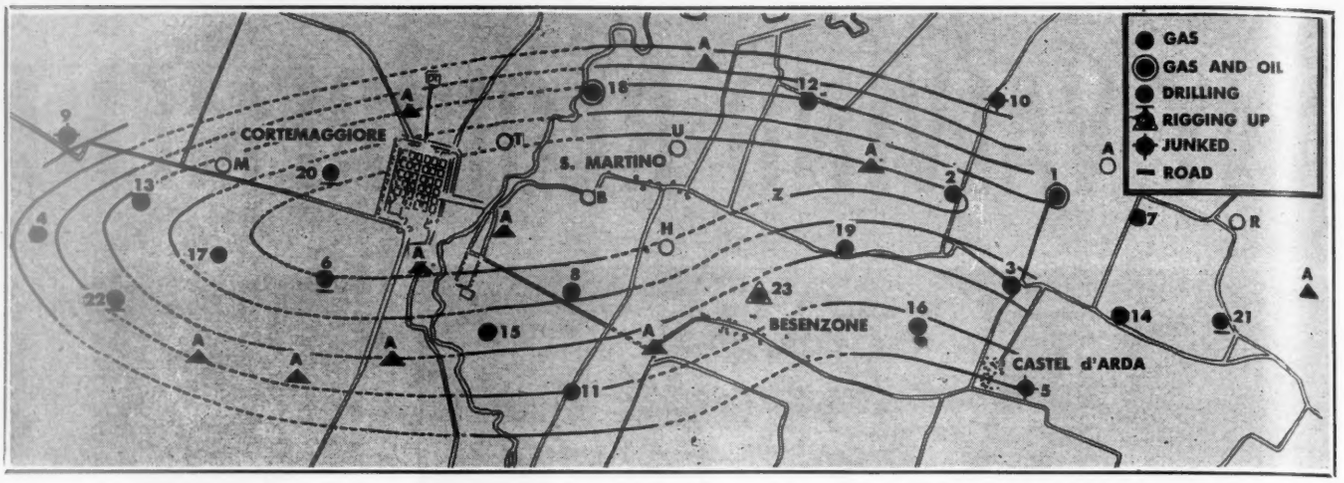

FIG. 3. Cortemaggiore oil and gas field was first drilled two years ago. Well No. 6 shown above is the deepest hole in Italy and still drilling below 11,400 ft in Miocene formation. The locations are indicated by letters above triangles.

out. An estimated 10,000,000 cu ft of gas and 1000 bbl of oil were daily produced for 21 days. It was finally capped, thanks to American experts. This well definitely establishes Cortemaggiore as an oil field. Together with the deep well No. 6 they open up tremendous oil and gas possibilities in the Pô Valley.

By November 1950, a total of 18 wells have been drilled as follows:

Productive wells:

a. Gas, Nos. 1, 2, 3, 4, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19.
b. Oil, Nos. 1 and 18.

Dry wells: 5, 9, 10.

The potential production is as follows:

a. Gas around 4,000,000 cu ft per well or for the 15 producers some 60,000,000 cu ft.
b. Oil unknown not tested extensively.

Ripalta

This is the third drilled anticline of the middle Pô Valley. It is situated (Fig. 1) north of Caviaga and only 6 miles from it. It is also a seismic discovery and the main axis is more or less east-west or parallel to Caviaga and Cortemaggiore. The first well Ripalta No. 1 was drilled on the 15th of March 1949 down to 5450 ft. It encountered from 5150 to 5390 ft the same sand already found in Caviaga and Cortemaggiore. The whole section is gas bearing. Three rigs are drilling at present in Ripalta. Five wells have been drilled (Fig. 4), Nos. 1, 2, 3, 4, and 5; three wells are drilling, Nos. 6, 7, 8, and two wells are rigging up, Nos. 9 and 10.

Their production is as follows: Nos. 1, 2, 3, 4, and 5 with 3/8 in. choke are producing 20,000,000 cu ft. No. 3 has been junked but revealed the presence of wet gas.

Soresina

The 4th anticline tested is Soresina. It is situated some 8 miles south east of Ripalta (Fig. 1). The first well drilled, Soresina No. 1, reached 5210 ft at the end of October 1950. It encountered a sandy shale section saturated with gas from 4610 to 5070 ft, and a sandstone and sand section (Tortonian) of the Miocene from 5143 ft to 5210 ft. These formations are different from the regular sands producing in Caviaga, Ripalta, and Cortemaggiore, but are also gas bearing.

Pontemure

A 5th structure also an anticline is being drilled and at the end of October 1950, the well, Pontenure No. 1. was down to 4320 ft. Nothing is known yet of its possibilities.

Cornegliano

A 6th structure also an anticline is being drilled West of Caviaga. At the end of October, Cornegliano No. 1 was down to around 4200 ft.

Geology and Geophysics

The complete geological column is given by the deepest well Cortemaggiore No. 6 as follows:

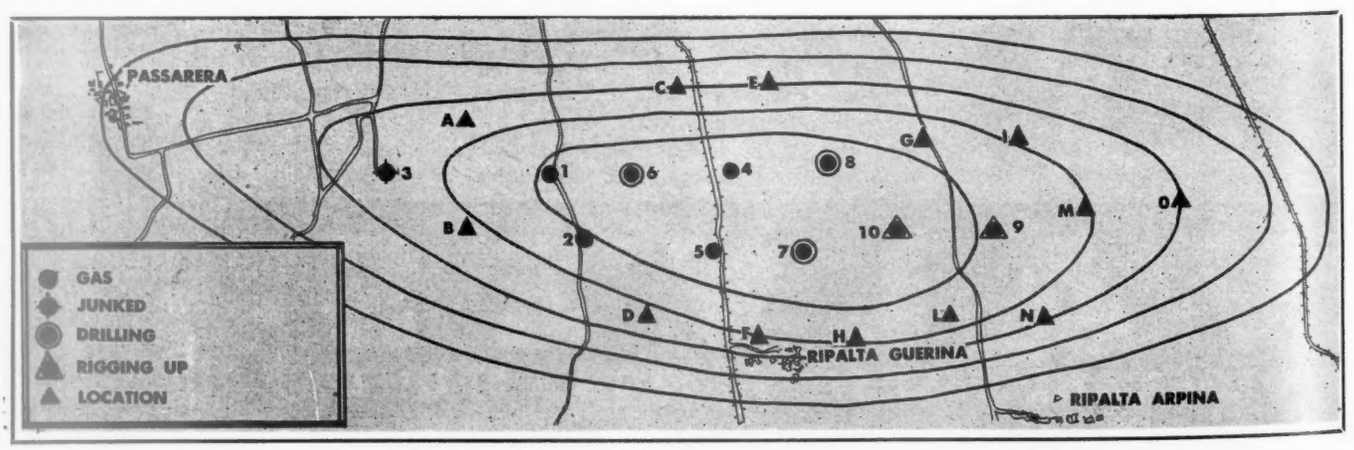

FIG. 4. Ripalta gas field is a seismic discovery made in Spring of 1949. Five wells are producing 20,000,000 cu ft of gas.

Pliocene—1600 ft Alluvions. Mostly fresh water sands with shale breaks.
1600-3450 ft Calabrian. Alternately salt water sands and shales.
3450-5000 ft Copertura shale.

Miocene — 5000-5800 ft Messinian sands and shale streaks. This is the producing section in Ripalta, Caviaga, and Cortemaggiore.
5800-6700 ft Tortonian (shales and sandy shales). This may be the producing section of Soresina.
6700-8700 ft Helvetian, mostly salt water sands.
8700-11,000 ft Helvetian, sands, sandstone, limestone, with streaks of hard shales.

All the structures drilled so far are of the anticline type. There are a large number of known structures to be drilled yet and the geophysical work is going full blast as follows:

1. Ten seismic parties:
   5 Western American for AGIP
   1 Western for Montecatini
   1 C.G.G. (French) for AGIP
   2 Italian for AGIP
   1 S.S.L. British for AGIP
2. Five gravimetric parties:
   2 for AGIP
   3 for various companies
3. One telluric party:
   C.G.G. French for AGIP

Drilling Activity

A total of 17 rigs are being operated by or for AGIP as follows:

	Year	
Ripalta 3 rigs		
1 Masserenti (Italian)	1950	8000 ft
1 Ansaldo (Italian)	1950	8000 ft
1 Cardwell American	1940	6500 ft
Cortemaggiore 7 rigs		
1 Ideco 1350 American	1949	15,000 ft
1 Ideco 525 American	1949	8,000 ft
1 National 75 American	1949	10,000 ft
1 Cardwell American	1940	8,000 ft
1 National 75 American	1950	10,000 ft
1 National American		
1 Ideco American	1950	10,000 ft
Caviaga 4 rigs		
3 Wirth German	1942	10,000 ft
1 Haniel-Luegg	1933	8,000 ft
Soresina 1 rig		
1 Wirth German	1935	8,000 ft
Cornegliano 1 rig		
1 Ansaldo Italian	1950	8,000 ft
Pontenure 1 rig		
1 Wirth German	1935	10,000 ft

In addition, 5 deep rigs are expected shortly as follows:
2 Haniel-Luegge German 1950 10,000 ft
3 Ideco 525 American 1950 8000 ft

Seven shallow rigs are available for shallow exploration:
3 Massarenti Italian 1941 5000 ft
2 Massarenti Italian 1940 3000 ft
2 Haniel-Luegg German 1940 4000 ft

Activity Outside the Central Po Valley

Outside the central Pô Valley, which is now virtually an AGIP monopole (no official mining law yet), there are several other interesting territories.

A. POLESINE (Fig. 1). This is a swampy region of the Pô delta. It produces gas from a very shallow depth (800 to 1500 ft) and a large number of shallow holes are drilled by a nearly equal number of operators (farmers, land owners, etc.) very much in the American fashion. They dig, with home made rigs, short lived small gas wells. However, the cost is very low and if the drilling is well conducted it is a paying proposition. Technically, it is also a curious case, the gas being trapped in a predominantly sandy section in thin sands overlaid by equally thin shale beds. The gas origin is completely unknown. Yet the total gas production of this territory is around 20,000,000 cu ft daily.

B. ANCOME. There are a succession of small valleys perpendicular to the coast and in which a number of structures have been outlined. Both AGIP and Montecatini are contemplating drilling there.

C. SICILY. Both Gulf Oil and MacMillan Company hold extensive concessions in Sicily with drilling contemplated in 1951-52.

Gas production in October 1950 was 40,000,000 cu ft daily.

Potential production is about 125,000,000 cu ft daily, with Cortemaggiore producing 60,000,000 cu ft daily, Caviaga, 45,000,000 cu ft daily, and Ripalta, 20,000,000 cu ft daily.

Pipe Line Facilities

Outside the Polesine, which has its own pipe line and distributing system, AGIP is building a network of pipe lines to distribute its already large known reserves estimated at 1200 trillion cubic feet. So far, the following lines are in operation:

Lines in service are:

Caviaga-Milano, 3-in., with a capacity of 5,000,000 cu ft daily;

Caviaga-Seto-San Giovani, 10-in., with capacity of 50,000,000 cu ft daily;

Caviaga-Ripalta-Bergamo, daily capacity of 20,000,000 cu ft, and

Caviaga-Reggio, daily capacity of 5,000,000 cu ft.

The Cortemaggiore-Cremona-Ripalta-Milano, 13-in., is being built, and will have a capacity of 70,000,000 cu ft. The Cortemaggiore-Torino-Genova, which is planned for this year, is a 24-in., and will have a capacity of 120,000,000 cu ft. * * *

U. S. MINE OUTPUT INCREASED 11 PER CENT

The value of mineral production in continental United States in 1950 increased 11 per cent over 1949 and totaled 11.7 billion dollars. The comparable value for 1949 was 10.6 billion dollars and for the record year 1948, 12.3 billion.

Although the huge value reflects a continuation of high prices, the quantity of minerals produced in 1950 was 10 per cent greater than in 1949 and only 4 per cent less than the all-time peak in 1948, according to the analysis submitted to Secretary of Interior Oscar L. Chapman by James Boyd, Bureau of Mines Director.

Mineral fuels, including petroleum and coal, comprised 8.7 billion dollars or three-fourths of the total value of all minerals produced in the U. S. in 1950.

Production of crude petroleum in 1950 was estimated at 1973 million barrels, an average of 5.4 million barrels daily. The 1950 output represented a gain of 7 per cent over 1949 but was 2 per cent less than the record production of 2020 million barrels in 1948. A further gain of about 6 per cent in crude oil production was forecast for 1951. The estimated value of crude petroleum at the well in 1950 was 5.0 billion dollars, an average of $2.54 a barrel, the same price as in 1949.

Imports of crude oil in 1950 increased 15 per cent over 1949; exports remained unchanged. Net imports of crude totaled 146 million barrels in 1950.

Marketed production of natural gas in 1950 was estimated to have increased 13 per cent over 1949 to a record 6124 billion cubic feet, valued at 404 million dollars at the well.

Production of natural-gas liquids was estimated to have increased 11 per cent in 1950 to 4620 million gallons and the production of liquefied petroleum gases to have increased 24 per cent to 3018 million gallons, both setting new records.

The increased output can be attributed to the large volume of gas treated and to more complete recovery of LP-gases from natural gas.

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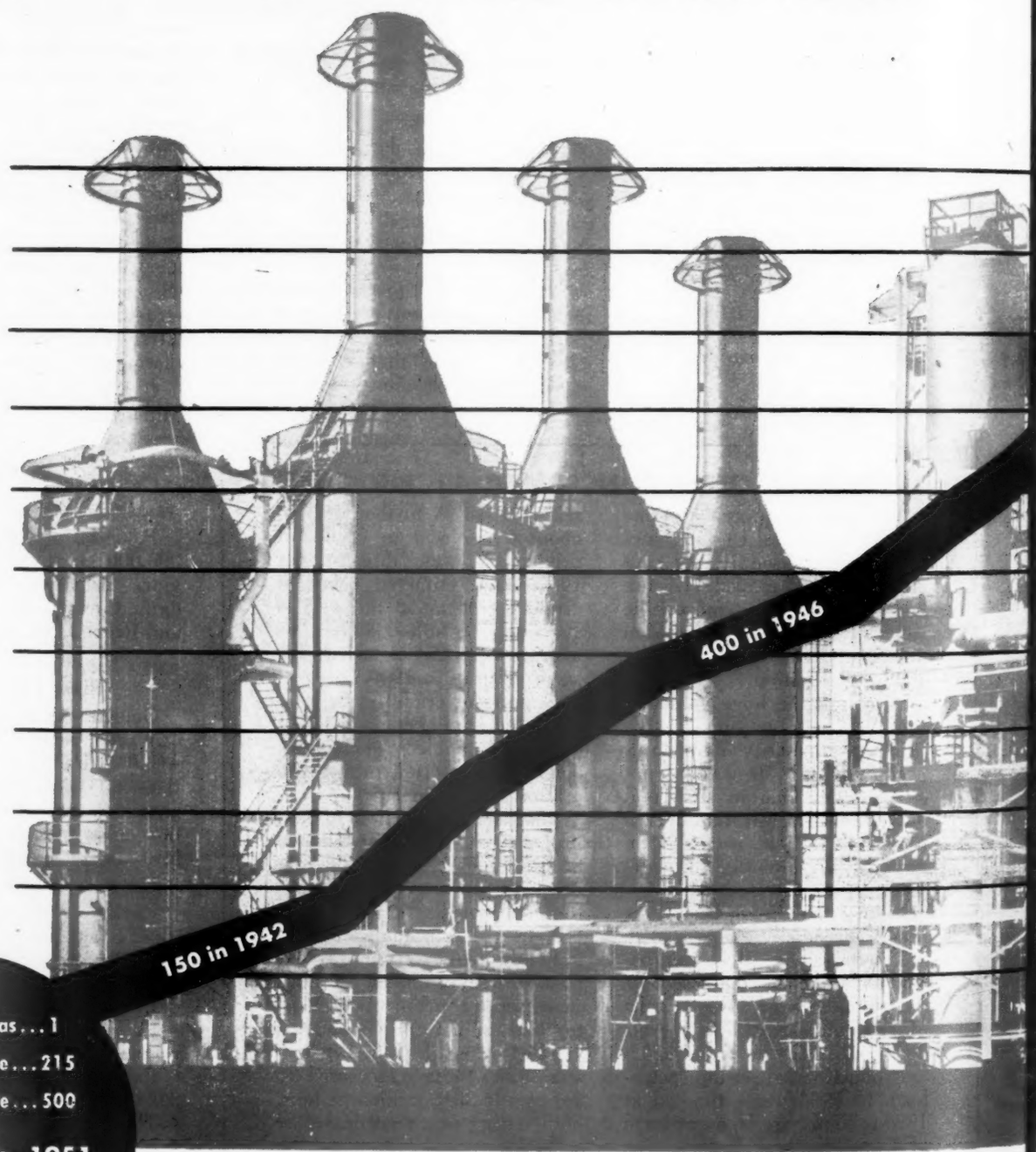
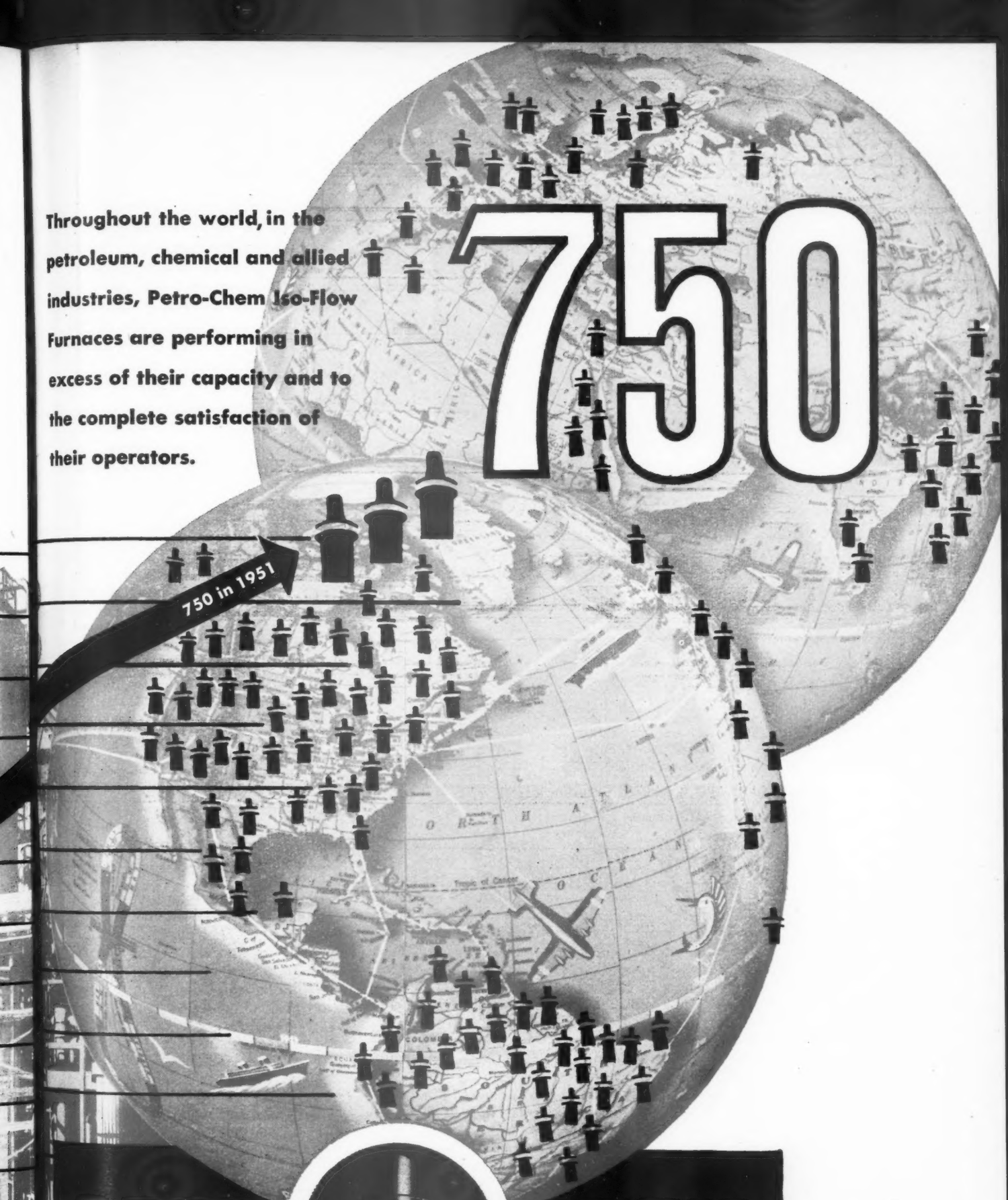


In 1940 there was . . . 1
In 1944 there were . . . 215
In 1948 there were . . . 500

and as of Feb. 1951
there are more than
750



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PETROLEUM PROFILE

D. P. BARNARD, Research Coordinator,
Standard Oil Company (Indiana)

WAY back about the end of World War I, "Dan" Barnard (D. P. Barnard IV to you!) came, like Old Joe Hooker, "out of the wilderness" of the University of Delaware, got mixed up with R. E. (Bob) Wilson and MIT, up Cambridge way, and has never recovered.

Latest evidence of this advantage, and of the work done during the last third of a century by Dan, is his receipt of the 1949 Horning Memorial Award, presented by the Society of Automotive Engineers at its 1951 Annual Meeting in Mid-January at Detroit, "In recognition of distinguished active service in the field of mutual adaptation of fuels and engines." Incidentally this is the most important field, in the opinion of leaders in both industries, within the realms of those industries for the advantage of and service to modern mankind, barring possibly medical research. The late Dr. H. L. Horning, head of Waukesha Motor Company, was one of the outstanding pioneer research and development leaders of all time, in whose honor this award is made.

Obviously, the Dan Barnard who received this award didn't "just happen." With a BS in chemical engineering from Delaware in 1919, he went to Massachusetts Institute of Technology to obtain the master's degree in 1921, the D. Sc. in 1926. Bob Wilson had gone to Standard of Indiana in 1922 to develop that company's far-flung research organization; Barnard came in 1925 to start its automotive engineering laboratory, as assistant director of research. Finally in 1945 he was transferred to the Chicago office from Whiting as research coordinator, a position loaded with the greatest importance to company and industry.

A pioneer group of leaders early saw the necessity for coordination between the automotive and the oil refining industries, in working out the most important correlation that could exist between the two outfits, each of which is the greatest consumer of the other's products. Out of that concept grew the Cooperative Fuel Research (CFR), without doubt the most comprehensive research organization in existence. In that system has come the idea of isooctane as the standard of anti-knock rating, along with normal heptane, the world-famous Uniontown Hill road tests, the development of Research, Motor and other methods of determination of anti-knock rating of motor and aviation fuels.

From this international cooperative work has developed the finest of all the engineering power progress that the world has ever seen. CFR grew into the Coordinating Research Council, via "Skipper" Veal and the pioneers in all this monumental work. Combined with the American Petroleum Institute this work expanded into diesel engine fuels and power, lubrication of all these units, without which of course little if any of the developed power could be delivered beyond the pistonhead. Of these world-leading groups, in 1949 and 1950, Barnard was president, having been in the ranks since 1923.

As an authority on petroleum and its products, "Dan" has been known for the last decade. Smiling, unassuming, unpretentious, he upholds the best of the high traditions of the world's great group of engineers. With the courage of his convictions he has been a Wings Club member since the '36 decade—flying a Waco—and has survived.

He is one of the veteran Motor Car Club members of the country! Pressed for facts, Dan will admit that within the confines of Dune Acres, Indiana, the home on which he pays bills and taxes he is harboring two fugitives from the (automobile) graveyard; a 1906 Cadillac, and a 1909 M10 Buick, that of the twin-cylinder, under-seat phaeton, or equivalent.

Now, rumor hath it that the acquisition of spare parts is the chief aim of Dan Barnard. When in the process of rejuvenating these Neolithic cars comes the inevitable exasperation—produced by what Mark Twain called "The Eternal Cussedness of Inanimate Things"—the DPB mechanic leaves one car and proceeds to attack the rejuvenation problems of the other.

Persistent lot, these Barnards. D. P. Barnard V, scion of the clan and employed by Humble Oil and Refining Company at Baytown, Texas, is recently the father of D. P. Barnard VI. He has a daughter married to F. S. Wood, research engineer for SOIndiana at Whiting laboratories.

Water...A Tool for Increasing Oil Recovery

ALTHOUGH operators still rue the day their oil wells begin to produce water, they are using more and more of it to revive production from abandoned pools and to increase or maintain production from old and new pools. In fact, the search for water to inject into oil pools is much greater in many areas than the search for new oil pools. Any kind of water that can be developed and treated for injection purposes is welcomed by the operators, provided there is sufficient volume at a low enough cost to make a water injection program economically attractive.

According to a recent report by Albert E. Sweeney, Jr., and Paul D. Torrey of the Secondary Recovery Committee of the Interstate Oil Compact Commission, a survey conducted in Kansas reveals that 159 water flood projects are now being operated in eastern Kansas alone. These projects cover about 25,000 acres in the old pools, many of which had been shut down or completely abandoned before the spread of waterflooding practices to this area from Appalachian fields during the past 15 or 20 years. This report indicates a tremendous growth of waterflooding since World War II as a result of success on earlier floods and more favorable economic conditions, such as increases in the price of crude oil.

About 500,000 bbl of water is being injected daily into some 4100 injection wells in eastern Kansas, and about 28,000 bbl of oil is being produced by some 5000 producing wells in these 159 projects. More than 10,250,000 bbl of oil was produced by these waterflood projects in 1949, which is a little more than 10 per cent of all the oil produced in Kansas in that year.

Remarkably little new steel has been required to develop this significant addition to our petroleum reserves. Many of the old wells have been used in the waterflooding programs. Many of the old lead lines, tanks, and gathering facilities have been rehabilitated by the operators in these shallow pools as a matter of economy. New wells often have little new pipe or tubing in them. Old equipment and old pipe line systems have been returned to use.

All in all, the significant growth of waterflooding practice in East Kansas, Northeast Oklahoma, North Texas, and many other shallow areas is a tribute to the operators who are using their ingenuity and resources to make money by flooding the last bit of oil out of these old pools with water. Government and industry organizations and publications that spread the news of these worthwhile developments are doing a real service.

Water, once the operators' enemy, has been converted by the operators into a valuable tool for obtaining much greater production from our proved producing areas.

—K.M.F.

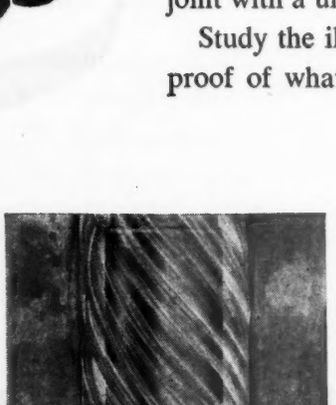
"Whirling on center" is the key to Cementing Success

NO OTHER EQUIPMENT—no other method of cementing—provides such assurance of successful "first-time" cementing as the exclusive Baker Principle of "whirling" the cement up and around casing which is effectively centered in the well with Baker Model "G" Casing Centralizers.

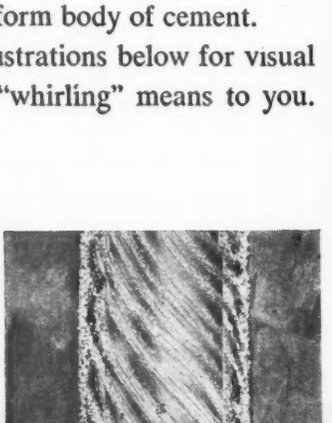
Not only can you REMOVE BRIDGES which might stick the casing; not only can you wash the wall of the hole to help REMOVE MUD CAKE and leave the formation prepared for effective bonding with the cement to follow, but the definite *downward*, then *upward* whirling motion of the cement slurry REDUCES THE HAZARD OF CHANNELING TO A MINIMUM, and assures COMPLETE ENCASEMENT OF THE PIPE at the critical shoe joint with a uniform body of cement.

Study the illustrations below for visual proof of what "whirling" means to you.

The downward hydraulicking action of the circulating fluid through the baffled side down-whirler ports, and the nozzle-like bottom passageway, effectively remove bridges and permits safe running of the casing string.



When washing the formation at the cementing point to condition the hole, the "whirling" motion of the fluid helps remove mud cake from side walls. This *downward* whirling is far superior to any *side* jetting action, and does not cause caving or crumbling of soft formations.



The "whirling" motion given to the cement slurry as it is discharged from a Baker Wash-Down Whirler Shoe causes the cement to encase the centered shoe joint with a uniform body of cement, and reduces to a minimum the hazard of channeling.

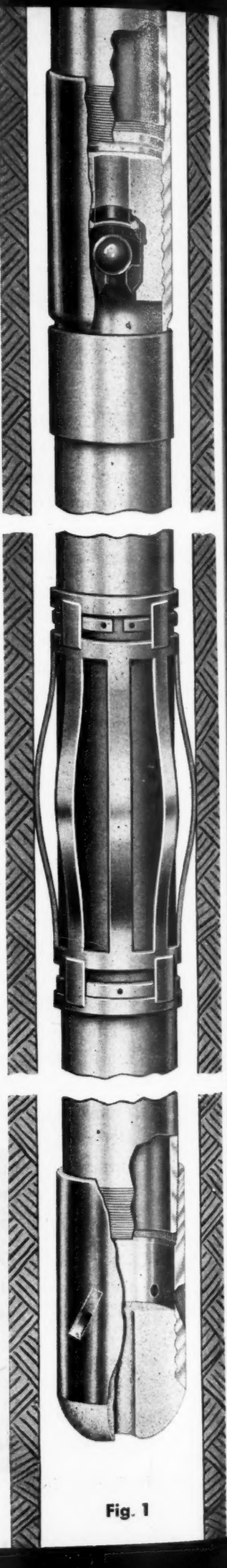


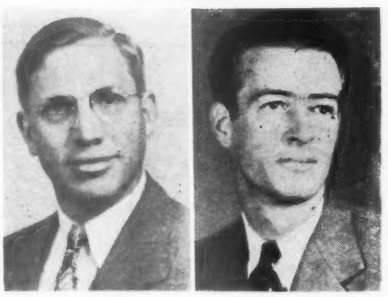
Fig. 1

Graphical Solution of Single Phase Flow Problems

E. R. BROWNSCOMBE and LOYD R. KERN

ALTHOUGH solutions describing the transient flow of single-phase fluids through linear and radial reservoirs have been published,[1] the average engineer has neither the time nor patience necessary to utilize these solutions in practical problems. The problems of interest to the oil industry generally have solutions in the form of infinite series of functions, many of which are not tabulated. The actual numerical solution in many cases is tedious to say the least. A very rapid graphical method of solution is presented here. The accuracy of the solution can be made as great as desired; however, rapidity is sacrificed as accuracy is increased. The method was developed by Schmidt[2] for use in heat flow problems. Several examples are given to illustrate the procedure.

The Authors



E. R. Brownscombe Loyd R. Kern

E. R. Brownscombe is associate director of research on crude oil production for the Atlantic Refining Company. Obtaining his Ph.D. from Yale in 1932, he joined Atlantic's Research and Development Department in 1934 where he worked on various refining problems. In 1942 he was transferred to Dallas as a part of Atlantic's new production research staff.

Loyd R. Kern, assistant reservoir engineer at Atlantic Refining in Dallas, Texas, received his M.S. degree in engineering physics from the University of Oklahoma. He has been associated with the Atlantic Refining Company since 1949 engaged in theoretical work in the field of petroleum reservoir analysis.

Linear Flow—Constant Pressures

Consider a reservoir of uniform cross-sectional area A and length L which is initially at a constant pressure p_i. The pressure at one end is suddenly lowered to p_f and maintained there, while the pressure at the other end is maintained at p_i; let us find the pressure within the reservoir as a function of time and position. The solution, partially completed, is shown in Figs. 1A-1C. The procedure is as follows: The reservoir is divided into an even number of equal zones of length $\triangle X$. A line is drawn from p_f at $X = 0$ to p_i at $X = 2\triangle X$. The intersection of this line with the inordinate $X = \triangle X$ gives the magnitude of the pressure at $X = \triangle X$ at the end of the first unit of time after the pressure is lowered at $X = 0$. This pressure is the point marked 1 in Fig. 1A.

The pressure at zero time is shown by the points marked 0. The next step is to connect the point 1 with p_i at $X = 3\triangle X$ (here $p = p_i$ at $t = 1\triangle t$). The intersection of this line with the ordinate $X = 2\triangle X$ gives the magnitude of the pressure at $X = 2\triangle X$ at the end of the two units of time. This pressure is the point marked 2 in Fig. 1b. The point marked 2 is then connected to p_f at $X = 0$ and p_i at $X = L$ (again, at $X = L$, $p = p_i$ at time $t = 2\triangle t$). The intersection of these lines with the ordinates $X = \triangle X$ and $X = 3\triangle X$ give the magnitude of the pressure at the end of 3 units of time, as shown in Fig. 1C. The dotted line in Fig. 1C is the pressure in the reservoir after two units of time. Note that the middle point of each line gives a value of p one time unit later than that of the points at its ends from which it is drawn.

Beginning with any distribution of pressure as a function of distance at a given time, the pressure distribution one time interval later may be determined by drawing lines that connect points which are $2\triangle X$ distance apart and which correspond to the same time. The heavy line in Fig. 1C shows the steady state solution that is reached after infinite time.

EXCLUSIVE

The unit of time, $\triangle t$, is

$$\triangle t = \frac{1}{2}\,\frac{f\beta\mu}{0.00633\,k}\,(\triangle X)^2 \text{ days} \quad \ldots\ldots\ldots (1)$$

where f is the fractional porosity of the formation

β is the compressibility of the fluid in $(psi)^{-1}$,

μ is the viscosity of the fluid in cp,

k is the permeability of the formation in md,

and $\triangle X$ is the length of the zones in ft.

Obviously, the accuracy may be increased by increasing the number of zones, although the time unit will be shortened thereby. The best procedure is to begin the solution with a large number of zones and gradually decrease the number of zones as the solution proceeds (bearing in mind that the unit of time must be changed when the number of zones is changed, in accordance with equation 1).

The production rate at any time may be calculated easily from Darcy's Law.

If the pressure is in psi, A is in ft^2, and k and μ are in the units given above, then the production rate q is

$$q = 0.001127\,A\,\frac{k}{\mu}\,\frac{\partial p}{\partial X} \text{ bbl/day.} \quad \ldots\ldots\ldots (2)$$

Thus, q may be calculated from the slope of the line in the first zone.

Linear Flow—Constant Production Rate

Consider the same reservoir as in example 1 except that the production rate instead of pressure is held constant at $X = 0$. As the production rate is constant, the slope of the lines in the first zone must be constant and have a value given by

$$\frac{\partial p}{\partial X} = \frac{q\mu}{0.001127\,Ak}\,\frac{\text{psi}}{\text{ft}} \quad \ldots\ldots\ldots (3)$$

The partial solution is shown in Fig. 2. The dotted lines marked 0-1, 2-3, 4-5 in the first zone all have the same

FIG. 1A FIG. 1B FIG. 1C

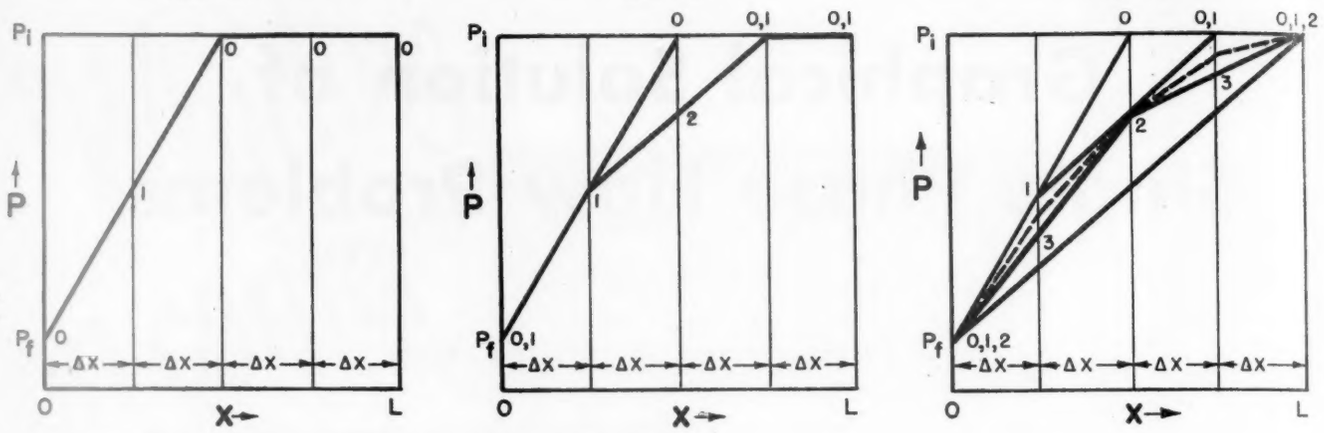


FIG. 1. Linear reservoir—pressure constant at boundaries.

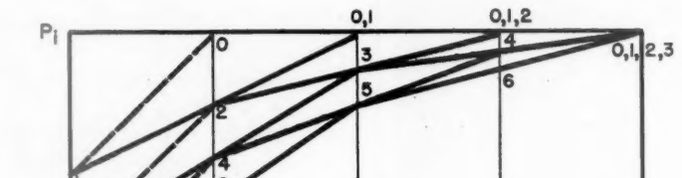


FIG. 2. Constant production linear reservoir—pressure maintained at outer boundary.

slope, namely that given by equation (3), and are drawn beginning from the points marked 0, 2, 4 at $X = \Delta X$. The solid lines shown in Fig. 2 are drawn in the following order: 1-2-1 in the first and second zones beginning at the left end of the 0-1 dotted line; 2-3-2 in the second and third zones; 3-4-3 in the first and second zones; 3-4-3 in the third and last zones; etc.

A curve drawn through a set of points with the same number gives the pressure distribution after that number of time intervals (interpolations being made on the ordinates not showing the time in question).

It is obvious that this method is admirably suited to solve practical problems with changing boundary conditions; for example, the production may occur in blocks with occasional shut-ins, in which case the slope of the pressure curve would be changed

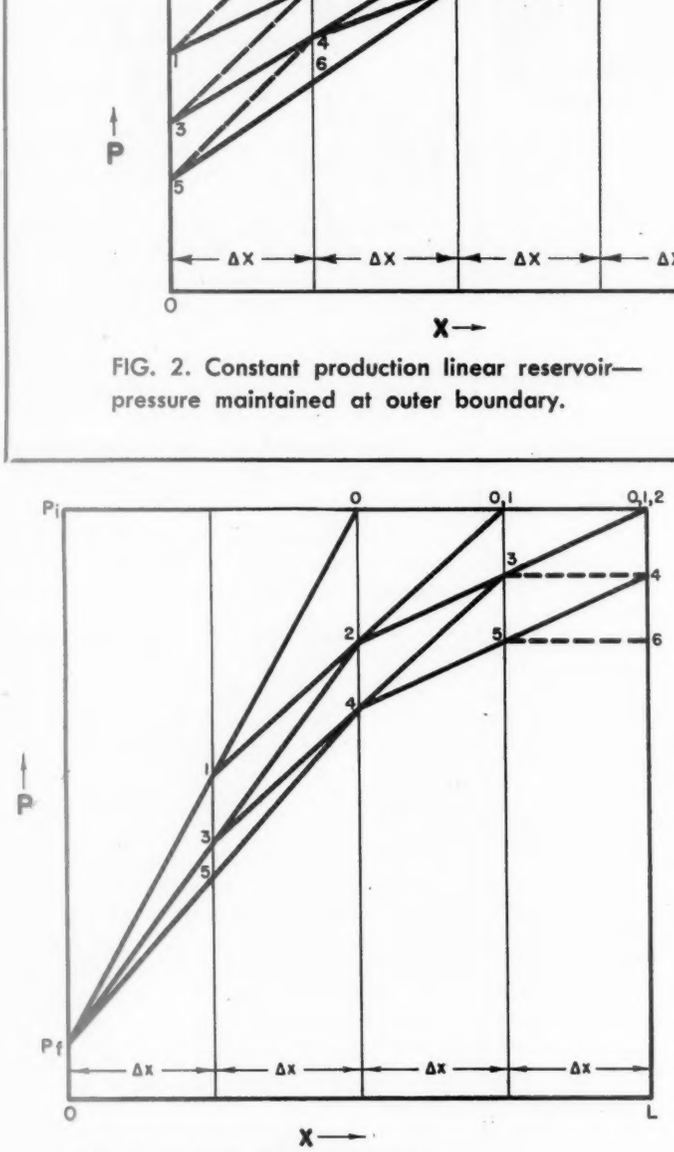


FIG. 3. Linear closed reservoir—pressure at well bore constant.

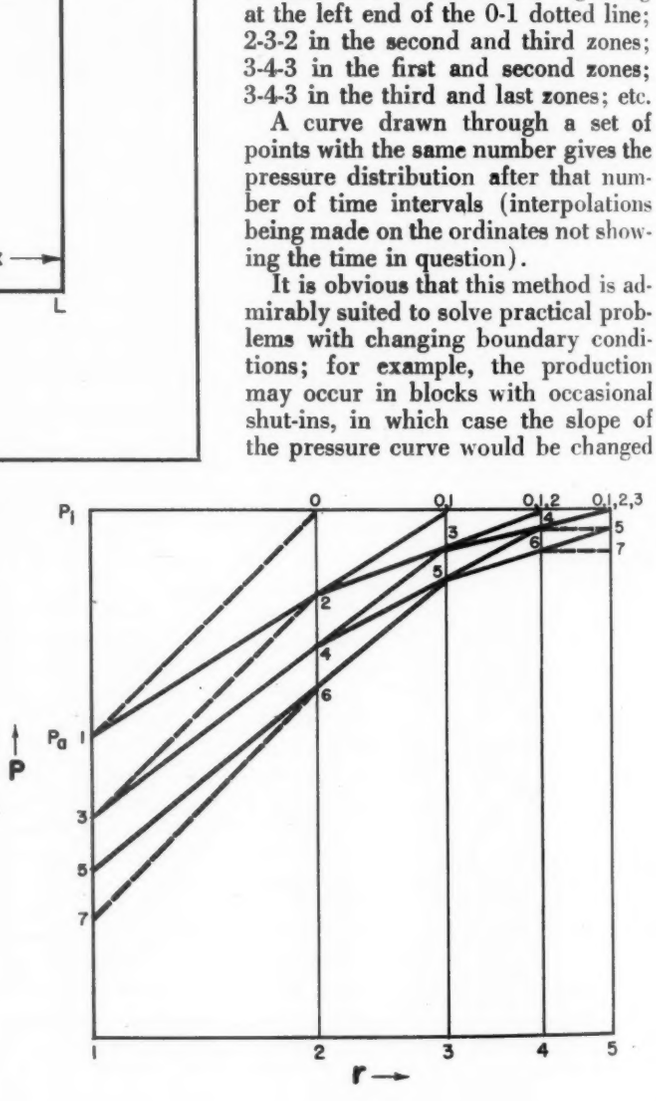


FIG. 4. Radial closed reservoir—constant production, $r_e/r_w = 5$.

correspondingly (zero slope for shut-in periods).

Linear Flow—Closed Reservoir

Consider the same reservoir as in example 1 except that the non-producing end is closed (no fluid flow across the boundary X = L). Here, the slope of the pressure curve in the last zone must be zero. The partial solution is shown in Fig. 3.

The dotted lines 3-4, 5-6, etc. in the last zone have zero slope, the right end of these lines being used to determine the position of the tie lines at X = L.

Radial Flow

Although the above examples are well suited for illustrative purposes, the flow of fluid in actual reservoirs is not linear but rather radial. Fortunately, the same procedures may be applied *provided the graphical solution is constructed on semi-logarithmic paper.* As an example of the method consider a radial system with an outer radius equal to 5 times the inner radius such as might obtain for example in a closed aquifer. Suppose that q bbl per day flow across the inner boundary.

The fluid in the system is initially at a constant pressure p_i and the flux across the outer boundary is zero; let us determine the pressure as a function of radial distance and of the time. The partial solution is shown in Fig. 4. As the flux across the outer boundary is zero, the dotted lines 4-5, 6-7, etc. in the outer zone are drawn with zero slope. As production is constant, the dotted lines 0-1, 2-3, 4-5, etc., in the first zone are all drawn with the same slope, the actual value of the slope being obtained from Darcy's Law for radial flow:

$$q = \frac{0.001127\ (2\pi kh)}{\mu}\ \frac{p_b - p_a}{\log_e r_b/r_a} \qquad . . . . . (4)$$

which in this particular case becomes

$$q = \frac{0.001127\ (2\pi kh)}{\mu}\ \frac{p_i - p_a}{\log_e 2/1} \qquad . . . . . (5)$$

where h is the effective pay thickness in feet.

The unit of time for the radial case is

$$\Delta t = \frac{1}{2}\ \frac{f\beta\mu}{0.00633\,k}\ (\Delta r)^2 \text{ days} \qquad . . . . . (6)$$

Equivalent Numerical Procedure

In practical problems involving radial flow the ratio of outer to inner radius will be much greater than that used in the preceding example (unless one is concerned with an aquifer). Consequently, the size of the outer zones on the semi-log paper will be very small compared with the size of the inner zones and serious graphical error may result. Such error may be avoided by employing an equivalent numerical procedure that with the aid of a hand calculating machine is no more time-consuming than the graphical procedure. If the pressure $p_{k,(n-1)}$ at $r = r_w + (n-1)\Delta r$ at the end of k units of time and the pressure $p_{k,(n+1)}$ at $r = r_w + (n+1)\Delta r$ at the end of k units of time have been calculated, the pressure $p_{k+2,n}$ at $r = r_w + n\Delta r$ at the end of $(k+1)$ units of time may be calculated from the equation

$$p_{k+1,n} = p_{k,n+1} + (p_{k,n-1} - p_{k,n+1}) \times \frac{\log\left[\dfrac{r_w + (n+1)\Delta r}{r_w + n\Delta r}\right]}{\log\left[\dfrac{r_w + (n+1)\Delta r}{r_w + (n-1)\Delta r}\right]} \qquad . (7)$$

which is readily derived from the geometry of the figure. The pressures at the boundaries must be calculated from the boundary conditions.

As mentioned previously, the value of the graphical method lies in the rapidity and ease of the solution of practical problems. With the aid of a hand calculating machine an unsteady state radial flow problem may be solved with a fair degree of accuracy in about 8 hours of calculating time.

As an example of the numerical procedure, consider a radial aquifer with a ratio of outer to inner radius equal to 10. Let us assume that the flux across the inner boundary is constant and the flux across the outer boundary is zero. The aquifer was divided into nine equal zones. The partial solution is shown in Table 1. Fig. 5 shows the calculated pressure drop at the inner boundary compared with the pressure drop obtained from the analytical solution. The analytical solution is from Hurst and van Everdingen[7]. Note that agreement is poor for early times. This may be remedied by employing a larger number of zones at the beginning of the calculations. Fig. 6 shows the calculated pressure distribution at the end of 63 time intervals compared with the pressure distribution obtained from the analytical solution.

TABLE 1. Unsteady state pressure distribution in closed radius aquifer.

Ratio outer radius/inner radius = 10. Constant rate of flow across inner radius.
Values in table are pressure decline $\times \dfrac{(0.001127)2\pi kh}{q\mu}$ at any time and radius.

$\frac{(0.00633)2kt}{fc\mu}$	$\frac{r}{r_w}$ = 1	2	3	4	5	6	7				
1	.6931										
2		.2556									
3	.9489		.1061								
4		.4170		.0463							
5	1.110		.2001		.0210						
6		.5358		.0992		.0094					
7	1.229		.2805		.0500		.0044				
8		.6305		.1506		.0253		.0021			
9	1.323		.3511		.0815		.0129		.0009		
10		.7099		.1994		.0444		.0064		.0009	
11	1.403		.4112		.1140		.0242		.0037		
12		.7771		.2438		.0654		.0131		.0037	
13	1.470		.4651		.1455		.0373		.0081		
14		.8358		.2851		.0870		.0219		.0081	
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
62		1.530		.8936		.5883		.4419		.3995	
63*	2.223		1.158		.7255		.5098		.4195		
64		1.551		.9144		.6088		.4619		.4195	

*63 time intervals required to reach equilibrium within 2 per cent. At equilibrium pressure is declining at same rate over entire aquifer.

Time for Equilibrium

Strictly speaking, the time required to reach the equilibrium state for any reservoir is infinite. From a practical point of view, however, we may designate the time required to reach equilibrium state as that time at which the transients in the solution become negligible. From an examination of the analytical solution it may be observed that this time depends only upon the porosity and permeability of the rock, the compressibility and viscosity of the fluid, and the ratio of the outer radius to the inner radius. An examination of the graphical solutions of several problems reveals that this time is almost independent

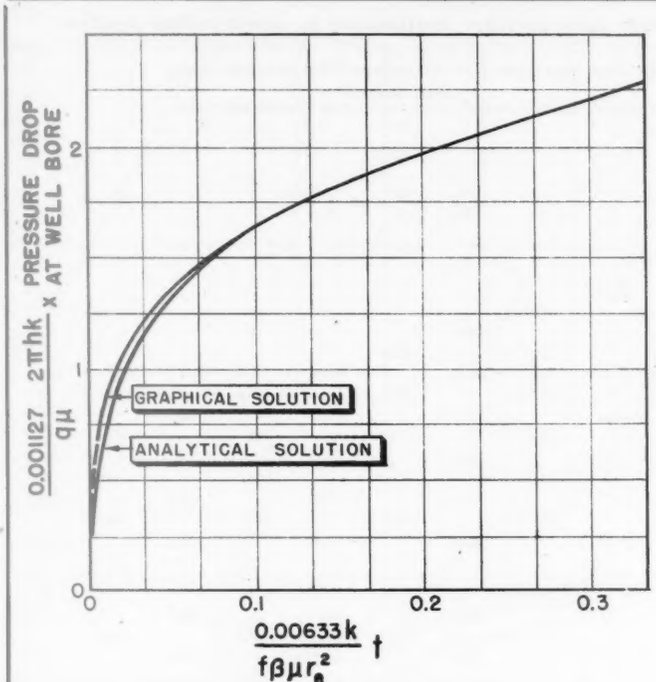


FIG. 5. Pressure drop at well-bore calculated from analytical and graphical solutions, $r_e/r_w = 10$.

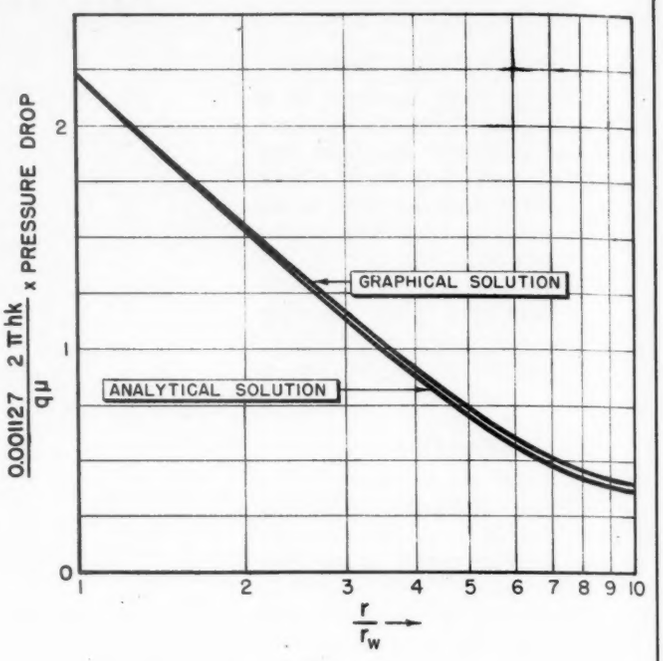


FIG. 6. Pressure drop as a function of radius at $t = \frac{(.315)\, f\beta\mu\, r_e^2}{0.00633\, k}$ from analytical and graphical solutions, $r_e/r_w = 10$.

of the size of the inner radius. For a closed reservoir that is produced at a constant rate, the time, t_s, required to place the reservoir within 2 per cent of equilibrium has been determined from the graphical solutions of several radial problems to be

$$t_s = 50\,\frac{f\beta\mu r_e^2}{k}\,\text{days} \quad . \quad . \quad . \quad (8)$$

where r_e is the radius of drainage. For a closed reservoir that is produced at a constant rate, equilibrium state is defined as that state in which the time rate of change of pressure is constant. Equation (8) will also apply approximately to other types of producing formations.

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Appendix

The basis for the graphical method for linear flow and the basis of special methods for radial flow are presented in several publications[3, 4, 5]. The linear case is included here with the development of the logarithmic coordinate method for the radial case for the sake of completeness. Credit for the development of the procedure for linear problems is given to Schmidt by McAdams[2]. For a liquid of sufficiently small compressibility, the equation of flow is

$$\frac{\partial^2 p}{\partial X^2} = \frac{f\beta\mu}{0.00633\, k}\,\frac{\partial p}{\partial t} \quad . \quad (9)$$

If the following approximations are made

$$\frac{\partial^2 p}{\partial X^2} \cong \frac{p(X+\triangle X,t) - 2p(X,t) + p(X-\triangle X,t)}{(\triangle X)^2}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

$$\frac{\partial p(X,t)}{\partial t} \cong \frac{p(X,t+\triangle t) - p(X,t)}{\triangle t}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

equation (9) becomes:

$$p(X,t+\triangle t) = \left(1 - 2\,\frac{0.00633\ \ k\triangle t}{f\beta\mu\ \ (\triangle X)^2}\right) \times p(X,t) + \frac{0.00633\ k\triangle t}{f\beta\mu\ (\triangle X)^2} \times [p(X+\triangle X,t) + p(X-\triangle X,t)] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

If $\dfrac{0.00633\ k\triangle t}{f\beta\mu\ (\triangle X)^2} = \frac{1}{2}$,

equation (12) becomes

$$p(X,t+\triangle t) = \tfrac{1}{2}\,[p(X+\triangle X,t) + p(X-\triangle X,t)] \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

Equation (13) is the justification for the graphical averaging process used in the examples. The question of convergence of solutions obtained by these methods has been investigated adequately by Fowler.[6]

Patton[5] gives a method of solving radial flow problems graphically by means of a specially constructed co-ordinate paper. Sherwood and Reed[8] refer to the use of semi-logarithmic co-ordinate paper by Nessi and Nissole for the graphical solution of radial flow problems. For the radial case, the equation of flow is

$$\frac{\partial^2 p}{\partial r^2} + \frac{1}{r}\,\frac{\partial p}{\partial r} = \frac{f\beta\mu}{0.00633\, k}\,\frac{\partial p}{\partial t}, \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

If the transformation $Z = \log_e r$ is made, (14) reduces to

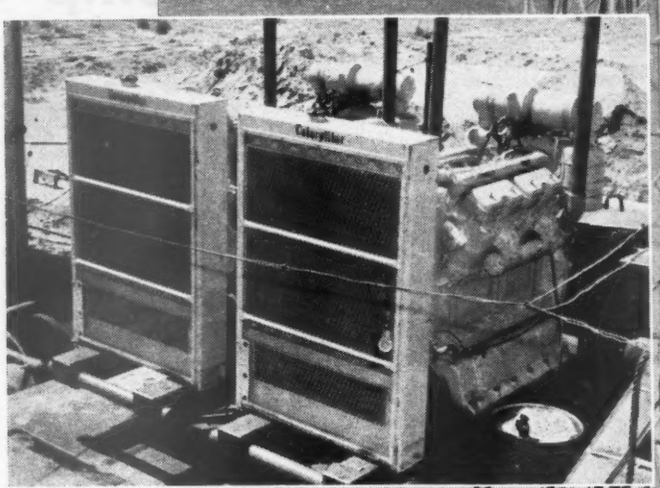
A couple of new hands make good!

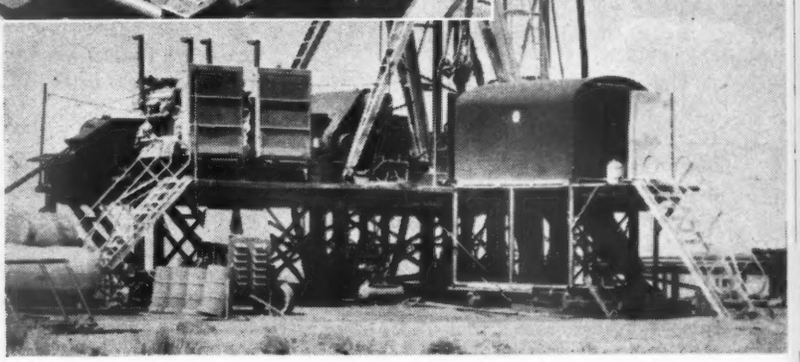
Typical of the reports coming in about "Caterpillar's" big new Oilfield Engines is this one from W. B. Barnett, driller for the Western Drilling Co., Lubbock, Texas. He says: "For twenty-four-hour service, efficiency and ease of operation, the two D375 'Cat' Oilfield Engines we have are the best I have operated."

These two D375s are compounded to drive the Oil Well mud pump and Emsco drawworks on this 8,500-foot rig in operation at Whiteface, Texas. When this picture was taken, the hole was down to 4,400 feet, with 600 to go. Time-table for the setup: rig up, 10 days; drill, 13; complete, 16; tear down, 1.

"Cat" Oilfield Engines, in 10 sizes up to 500 HP., are designed for rugged oilfield duty. They're compact, yet they deliver plenty of power—their rating is honest. They're tough, built to stand up under the roughest rig service. And they're dependable, engineered to stay in there pitching with a minimum of down-time. For your electrical needs, "Caterpillar" Diesel Electric Sets are built in 10 sizes up to 314 KW.

There's another big plus for you when you use "Caterpillar" power. That's the on-the-job service from your "Caterpillar" dealer, on call day and night. His servicemen are skilled and his up-to-date shop is well stocked. Under current conditions, you'll find it well worth your while to talk over your requirements *now* with him.





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"Caterpillar" fuel lines are made of cold-drawn seamless steel tubing. All lines are the same length to give identical spray characteristics at each cylinder. Able to withstand pressures of 3,000 to 5,000 lbs. per sq. in., the metal is hard yet capable of being cold-formed without excessive spring-back. The bore is free of injurious cracks and seams and has uniform diameter. Look under the hide for built-in quality.

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$$\frac{1}{r^2}\frac{\partial^2 p}{\partial Z^2} = \frac{f\beta\mu}{0.00633\ k}\frac{\partial p}{\partial t}, \quad (15)$$

If the same type of approximations are made as previously and

if $\triangle t = \frac{1}{2}\frac{f\beta\mu(\triangle r)^2}{0.00633\ k}$, (15) becomes

$$p(Z, t+\triangle t) =$$

$$\frac{1}{2}\left[p(Z-\triangle Z, t) + (p(Z+\triangle Z, t)\right], \quad (16)$$

since $r\triangle Z = \triangle r$. Thus the graphical solution for the radial case is equivalent to that for the linear case if the solution is made on semi-logarithmic paper.

Dimensionless groups are an important consideration in practical problems of this nature. For instance, if we let

$$\bar{p} = \frac{(0.001127)(2\pi kh)}{q\mu}(p_i - p) \quad (17)$$

$$\bar{t} = \frac{0.00633\ k}{f\beta\mu\ r_e^2}\,t \quad (18)$$

and $$\bar{r} = \frac{r}{r_w}, \quad (19)$$

then the equation of flow for the radial case becomes

$$\frac{\partial^2 \bar{p}}{\partial \bar{r}^2} + \frac{1}{\bar{r}}\frac{\partial \bar{p}}{\partial \bar{r}} = \frac{r_w^2}{r_e^2}\frac{\partial p}{\partial \bar{t}} \quad (20)$$

For a closed reservoir operated at constant production, the boundary conditions become at $r = r_w$, $\bar{r} = 1$,

$$\frac{\partial \bar{p}}{\partial \bar{r}} = 1 \quad (21)$$

$$\text{at } r = r_e,\ \bar{r} = \frac{r_e}{r_w}\frac{\partial \bar{p}}{\partial \bar{r}} = 0 \quad (22)$$

$$\text{at } t = 0,\ \bar{t} = 0,\ \bar{p} = 0 \quad (23)$$

The graphical solution of equation (20) with boundary conditions (21), (22) and (23) will describe the behavior of all single phase homogeneous reservoirs with the same ratio of outer to inner radius irrespective of rock and fluid characteristics. In other words, if a chart such as Fig. 4 has been prepared for a particular ratio of outer and inner radii it can be used for any system by choosing the proper scale factors (including the time interval according to equation 6). In the linear case there is no ratio of boundaries involved and one graph applies to all cases with boundary conditions of the same type.

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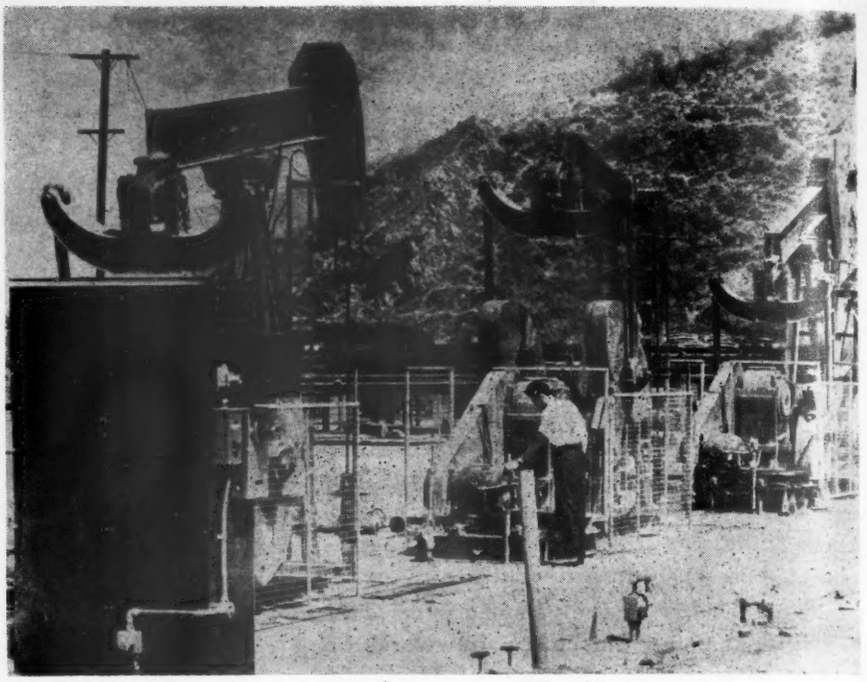


FIG. 1. One of the Shell Oil Company leases near Santa Paula, California showing the control center installation at the end of the concrete pad.

Well Pump Control Center

E. H. HULSE*

SHELL Oil Company, at a lease near Santa Paula, California, has installed a control center to supply power to a group of oil well pumping motors. Directional drilling methods were utilized to drill eight wells from a single concrete platform to reduce location expense in this mountainous terrain.

An individual outdoor-type starter unit for the motor on each pumping unit would have been required under ordinary conditions. Such an installation, where 6 or 8 wells are involved, would result in high wiring and labor costs.

To reduce these costs, Shell Oil installed a control center** with all motor starters, the main breaker, and metering equipment housed in a free-standing, weatherproof enclosure at one end of the concrete foundation slab. Power is supplied by the control center to each of the eight motors; each motor is started individually by its own pushbutton located at the pumping unit.

Through the use of this control center, space is saved, installation time is reduced, and provision has been made for the possible future addition of more motor starter units. Savings of $300 to $400 are possible on an installation such as this. * * *

FIG. 2. Close-up of control center.

*Application Engineer, Westinghouse Electric Corporation, Los Angeles, California.
**Manufactured by Westinghouse.

How to meet...
YOUR SPECIFIC GAS PROBLEMS

Tell us—

INTAKE PRESSURES AVAILABLE...

DISCHARGE PRESSURES REQUIRED...

STATION CAPACITY:

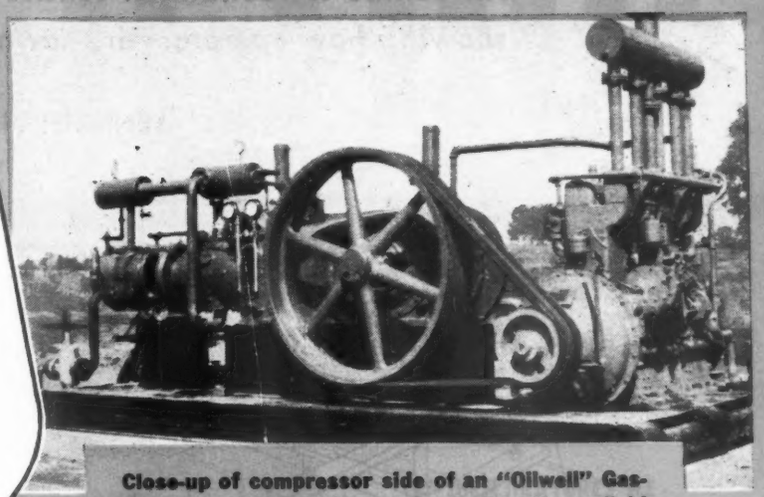
Cu. ft. per 24 hours

TYPE OF APPLICATION:

Gas Transmission.....

Underground Storage....

Other.....



Close-up of compressor side of an "Oilwell" Gas-Booster...2-stage type...in an East Texas field four-unit installation...involving a total of 600 horsepower.

and give

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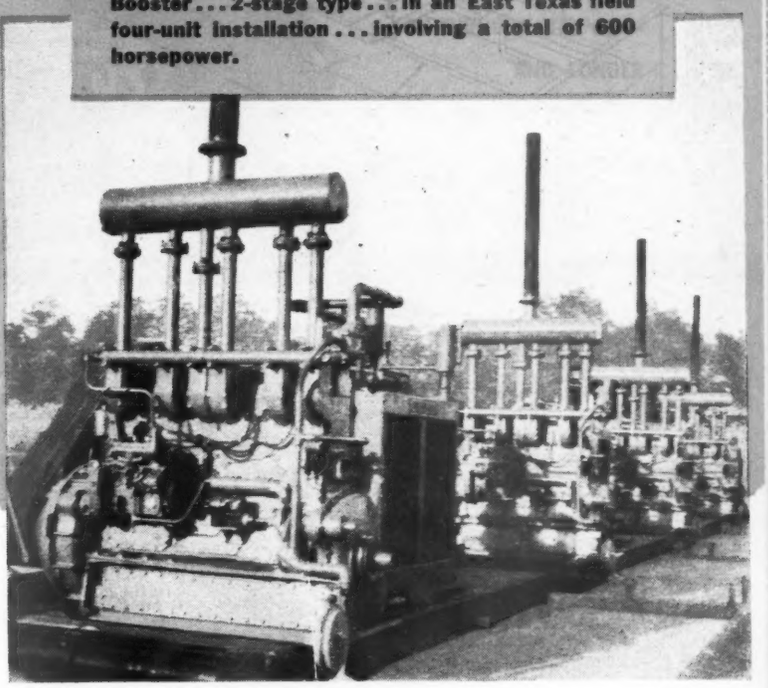

"Oilwell" Gas-Booster Units are of single or multi-stage design, complete with gas engines specially equipped for gas-booster service. They include heavy-duty V-belt drives, fan-type coolers for both engine and compressor and necessary pressure gauges—all ready to tie-in and start.

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Installation of Pumping Units

An outline of foundation construction problems and standards showing how operators are saving steel, cement, and expense.

KENNETH N. MILLS*

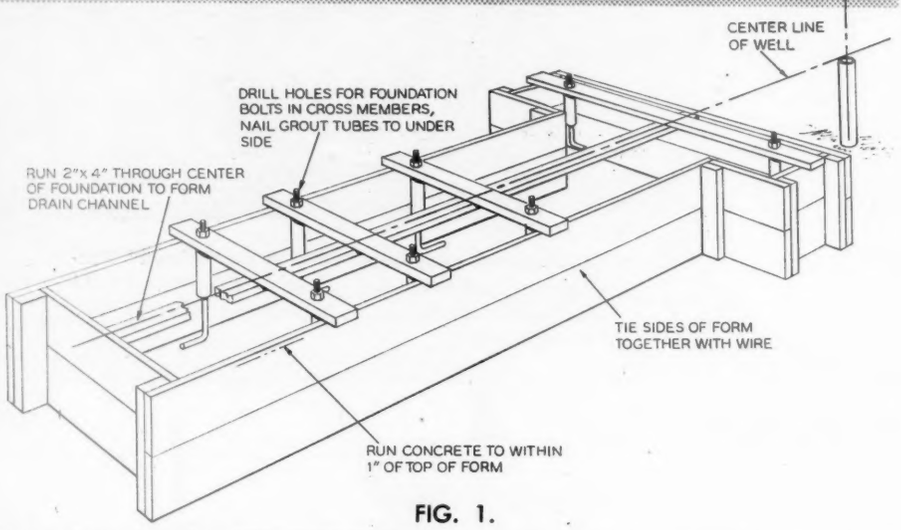
CENTER LINE OF WELL
DRILL HOLES FOR FOUNDATION BOLTS IN CROSS MEMBERS, NAIL GROUT TUBES TO UNDER SIDE
RUN 2"x 4" THROUGH CENTER OF FOUNDATION TO FORM DRAIN CHANNEL
TIE SIDES OF FORM TOGETHER WITH WIRE
RUN CONCRETE TO WITHIN 1" OF TOP OF FORM

FIG. 1.

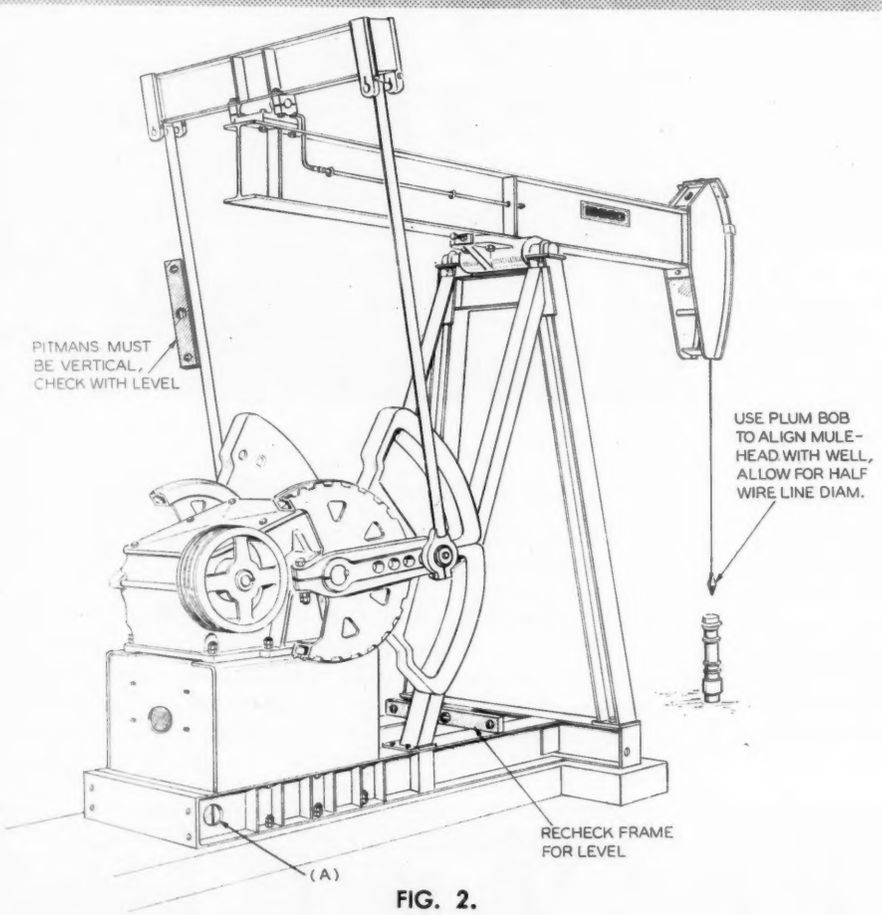
PITMANS MUST BE VERTICAL, CHECK WITH LEVEL
USE PLUM BOB TO ALIGN MULE-HEAD WITH WELL, ALLOW FOR HALF WIRE LINE DIAM.
RECHECK FRAME FOR LEVEL
(A)

FIG. 2.

THE cost of installing a pumping unit is influenced by the type of unit selected and the design of the foundation. The design of the foundation can have a material influence on the successful operation of the pumping unit, because it must support the applied loads with a minimum of settling to assure maintenance of proper alignment in the pumping unit. The type of foundation selected is influenced by soil conditions, possibility of flooding by high water, and permanency of the installation. The increasing costs of foundation material and labor have been responsible for the development of a wide range of installation methods and new conceptions in pumping unit design. Some of the latest developments in pumping unit installation methods were made possible by the new conceptions in pumping unit design. These new installation methods increase the flexibility of pumping unit application and decrease the cost of the installation.

When a conventional pumping unit is installed on a concrete foundation, the foundation must be properly aligned with the well, and it must have sufficient bearing area to support the applied load without settling. The alignment of the foundation with the well is established when the form for the foundation is constructed. One type of form design that will provide good alignment is shown in Fig. 1. In this design it may be noted that the foundation bolts are supported in drilled holes in cross members and the grout tubes are attached to the under side of these cross members. If the cross members are drilled after the form is completed and are located from a "chalk line" through the center of the well, they can be located in proper alignment with the well. As they are rigidly supported, they will remain in their proper location when the form is "poured."

After the foundation has been

*International Derrick and Equipment Company, Mechanical Product Manager, Columbus, Ohio.

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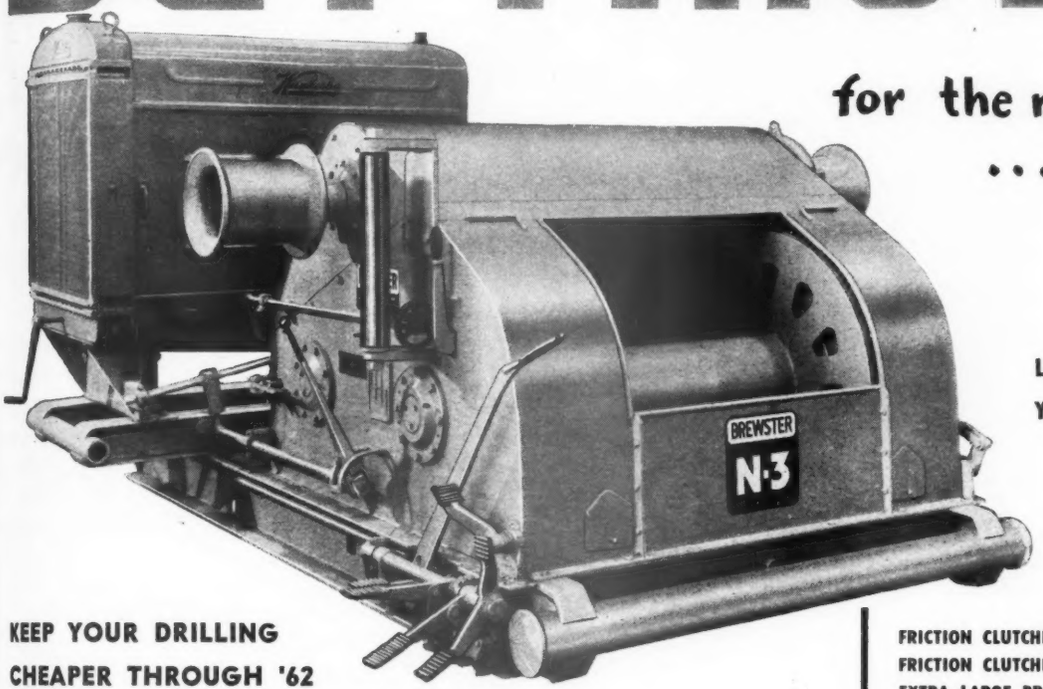

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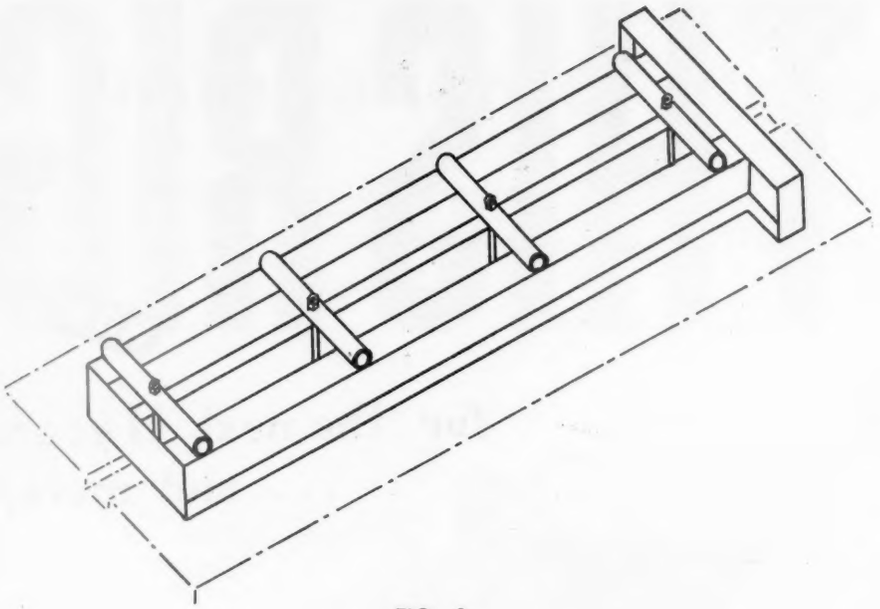

FIG. 3.

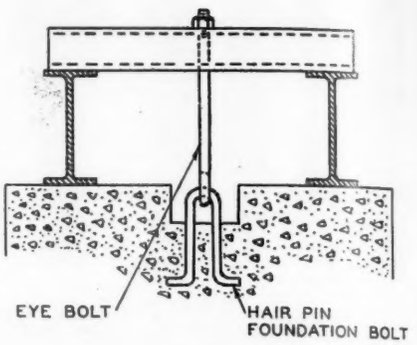

FIG. 4.

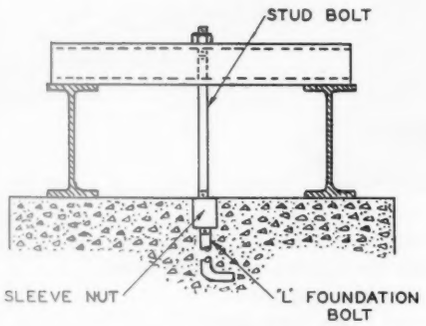

FIG. 5.

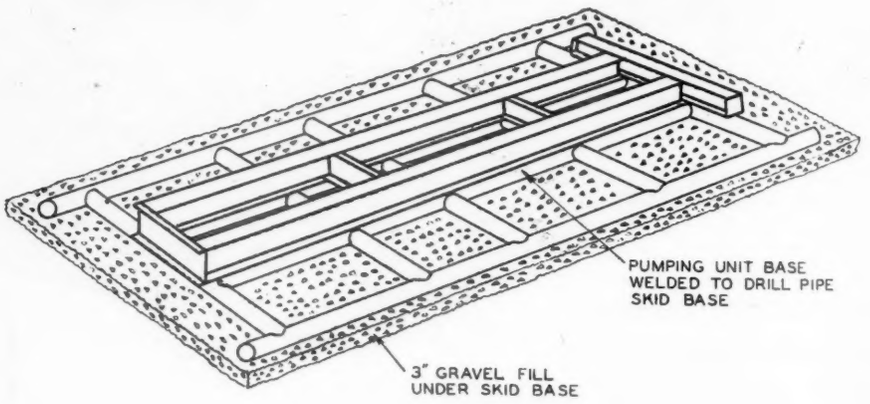

FIG. 6.

poured and the concrete has set, the pumping unit can be assembled on the foundation. To aid in leveling, it should be supported on several wooden blocks located under the frame adjacent to the foundation bolts. The first operation in aligning the pumping unit should be shimming under the frame until it is level at the samson post and on both sides of the speed reducer. Then the beam should be shifted until the pitmans are vertical. This can be checked with a level as shown in Fig. 2. When the frame is level and the pitmans are vertical, the unit should be aligned with the well. This alignment can be checked with a plum bob as shown in Fig. 2.

After the unit is aligned with the well the space between the frame and the foundation should be filled with grout. To provide satisfactory foundation life, the grout should completely fill the space between the foundation and the frame, and all of the grout tubes must be filled with grout. If they are not filled with grout, water may collect in them. Should water collect and freeze in the tubes, it will crack the foundation. If the space between the frame and the foundation is not completely filled with grout, the grout may fail in the highly loaded areas. This type of foundation failure might subject the pumping unit frame to stresses that would cause its failure.

The introduction of pumping units with the reducers elevated to keep the crank swing above the lower side of the frame has increased materially the flexibility of pumping unit installation. When the pumping unit is mounted on a conventional type foundation it eliminates the necessity for a large portion of the form work and materially reduces the amount of concrete required. Also, it simplifies the application of pumping units on temporary foundations.

Operating practices in some California fields necessitate the exchange of pumping units. This practice has resulted in the development of a universal-type foundation. This type foundation requires the use of a "floor clearing" pumping unit with an elevated reducer. One conception of this type foundation is shown in Fig. 3. In this diagram it will be noted that a series of "eye" type foundation bolts are located on the centerline of the well. These "eye" bolts are attached to the concrete foundation with "hair pin" foundation bolts. The pumping unit is secured to the foundation with cross members on top of the frame members as shown in Fig. 4. The design of the foundation bolts in this construction can be varied, i.e., flush sleeve nuts can be used as shown in Fig. 5, or standard foundation bolts can be used to hold the pumping unit to the foundation. The hold-down bolt location should be planned so hold-downs will be located on each side of the speed reducer and near the well end of the frame. As the hold-down bolts do not pass through the frame members, their location can be selected so two or more sizes of pumping units can be placed on the same foundation. To provide proper load transfer from the pumping unit frame to the foundation, the pumping unit

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The MULTIPLEX is the *shortest* Block and Hook Assembly made. It combines Block, spring-loaded Link Ears and Hook all in *one* compact unit that is not only short—*but also unusually narrow.* We invite you to compare dimensions of the MULTIPLEX with those of *any other* Block and Hook of comparable capacity!

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RUGGED BODY CONSTRUCTION carries the entire load on an internal framework of heavy rolled steel plates through which pass the heat-treated center and coupling pins. Cast steel outer shell is completely free of load stresses, assuring maximum strength for heavy-duty service.

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COMPLETELY STREAMLINED design will not catch in rig or equipment. Even bolts, pins and grease fittings are fully recessed.

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DOUBLE-ROW TAPERED BEARINGS on *each* sheave carry full radial loads, as well as any thrust loads caused by fleet angle or spread of lines. Individual grease ducts to each bearing assure positive and uniform lubrication!

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CLOSE-COUPLED SHEAVE DESIGN (no spacer plates—narrow-width bearings) reduces Block width to a minimum. Sheave spacing is same as Baash-Ross "DCO" Crown Block to eliminate fleet angle and drift.

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SPRING-LOADED HOOK (full 6" spring travel) eliminates shock when picking up loads, reduces wear on bearings and other parts.

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FULL-SWIVELLING HOOK ASSEMBLY rotates freely through complete 360° circle—or can be quickly locked in any of *eight* equi-spaced positions.

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INDIVIDUAL GREASE DUCTS to each bearing are machined into the heat-treated center pin, with recessed grease fittings conveniently located on outside.

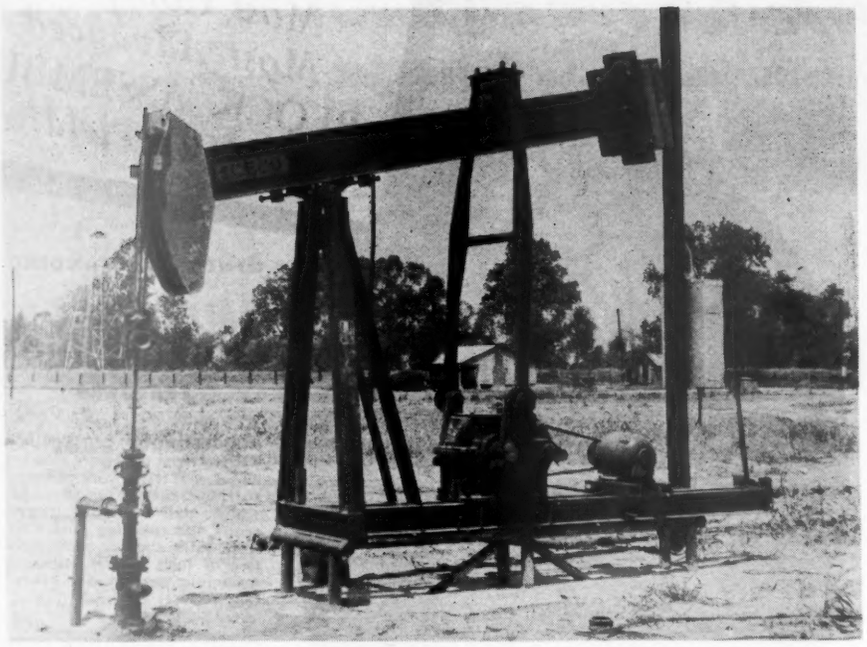

FIG. 7.

should be "grouted" on when used on this type foundation.

Another type of flexible installation practice has been developed in Kansas. In this practice the pumping unit frame is welded to a wide skid that is fabricated from old drill pipe, and this skid is placed directly on the ground. A typical design of an installation of this type is shown in Fig. 6. In this design it may be noted that the drill pipe skid has four longitudinal runners. Two of these runners are located directly under the frame members, the other two runners are located on the outside and form "outriggers" that increase the stability of the unit. The pumping unit frame must be welded securely to the pipe members under the frame members, because they reinforce the frame members and help prevent excessive frame deflections and stresses. Due to the limited bearing area of this type base, it should be placed on a shallow gravel fill. This practice will help prevent settling of the foundation when the soil is damp. The pumping unit should be levelled and aligned with the well before placed in operation.

Another type of installation practice that eliminates a large portion of the concrete and all of the form work has been developed in Louisiana. A pumping unit installed on this type foundation is shown in Fig. 7. In this illustration it may be noted that the pumping unit is mounted on a welded-pipe base that is supported by several pipe columns. These pipe columns are set in concrete, and these concrete piers provide the bearing area required to support the pumping unit. After the pipe base is installed, the pumping unit is placed on the base and leveled and aligned with the well. When it is in proper alignment, it is welded to the pipe brace.

In cases where it is desired to make a quick temporary installation of a pumping unit, it can be placed on a wooden foundation. A typical design for a wooden foundation is shown in Fig. 8. To prevent excessive settling of the foundation in damp ground, the timbers should be placed on a gravel fill. The pumping unit should be bolted to the timber stringers under the frame with "through" bolts. This practice will transfer some of the frame loads to these timbers and prevent excessive frame stresses.

Regardless of the type of foundation used, the pumping unit frame members should be attached securely to the foundation, and these attachment points should be located near or at the heavily loaded points. Also, the pumping unit should be leveled and aligned as shown in Fig. 2. Proper installation should provide minimum loads in all members and should help prevent expensive service failures.

* * *

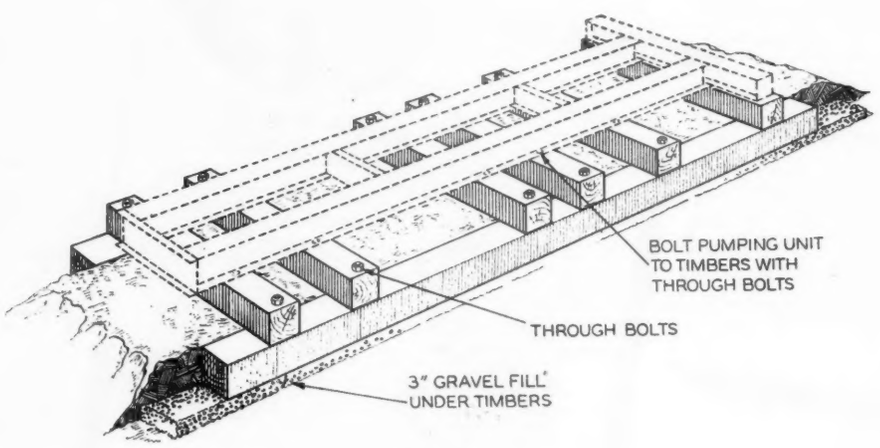

FIG. 8.

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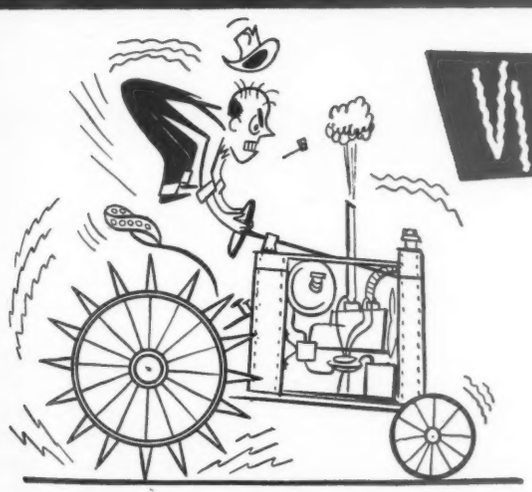
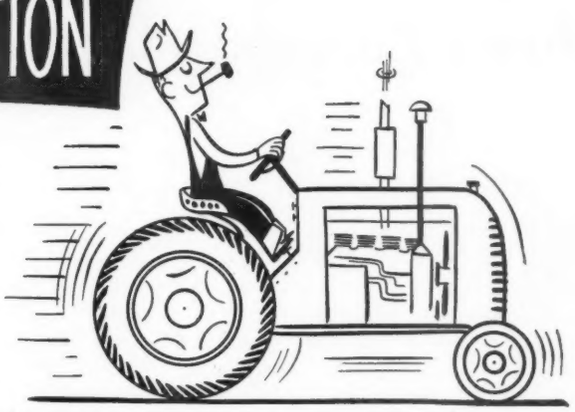


Imagine a core barrel vibrating around in the hole and without stabilization!



Visualize the core barrel stabilized and running smoothly on bottom. These are exactly the conditions under which a diamond bit and core barrel operate.

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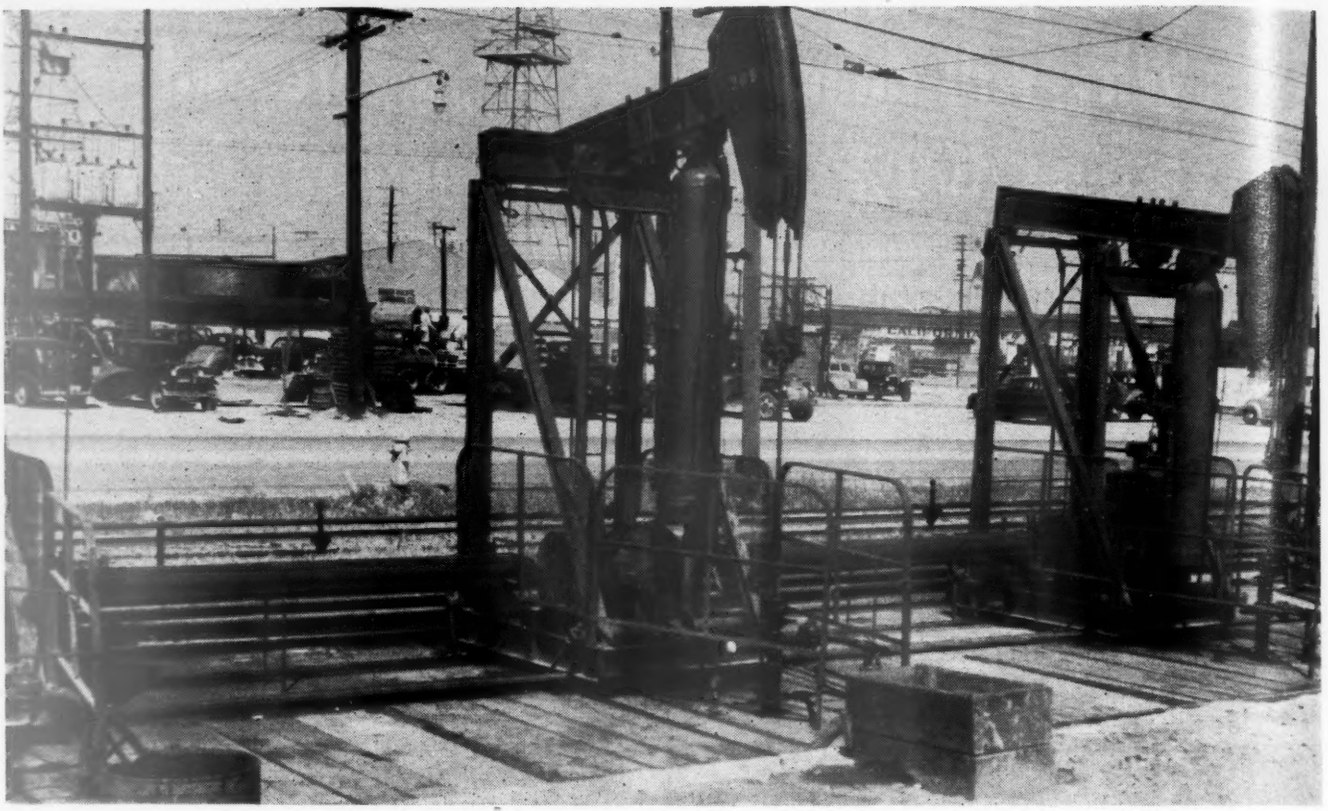

Arrows indicate two tubular shafts that drive two units (in center and at left) from engine-equipped unit at right on a narrow surface lease in the Long Beach field. Wells are bottomed under the Los Angeles River.

Three Pumping Units Operated by One Engine

J. C. ALBRIGHT

MULTIPLE pumping is being practiced by an operator* at Long Beach, California, by supplying power to pump three wells with only one gas engine. The wells on this property were drilled with surface equipment placed on the west bank of the Los Angeles river, between the levee of the Flood Control channel and Pico Avenue. Directional control methods were employed to tap productive sands beneath the river and portions of Long Beach. A meticulous survey was made so as to place the casing-heads in straight line, spacing the surface equipment for each well 18 ft apart. Although these wells did not flow when originally drilled because of low formation pressure, each well has consistently produced its allowable quota of oil by pumping. Pneumatically balanced pumping units** were installed at each well with identical equipment, so as to reduce maintenance costs and to minimize the quantity of warehouse stocks.

As the group of wells were in a straight line, and an exact distance from each other, it was decided to experiment with some method that might be used to pump more than one well with only one gas engine. Central powers, rod lines, and swings could not be installed, because of the narrow strip of land upon which the long line of surface equipment had been placed. After experimenting with several different miniature shop

*Continental Consolidated Oil Company, Ltd.
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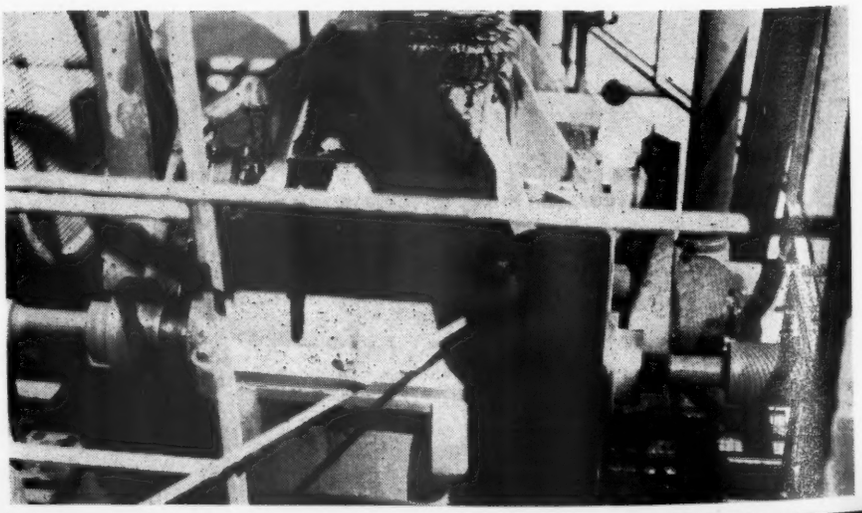

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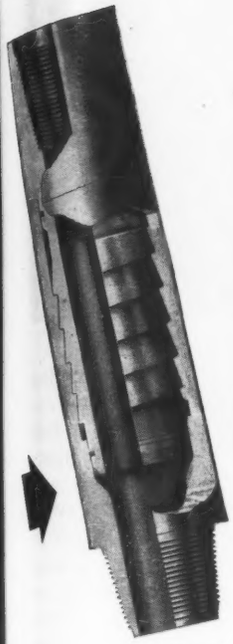

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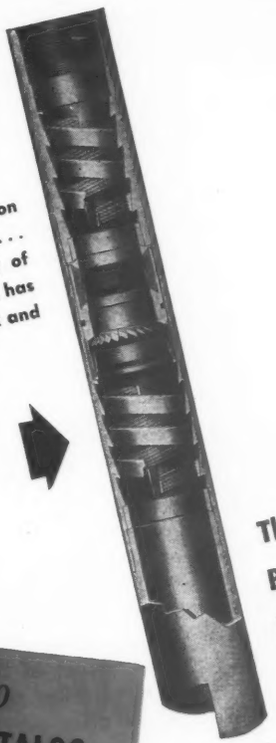

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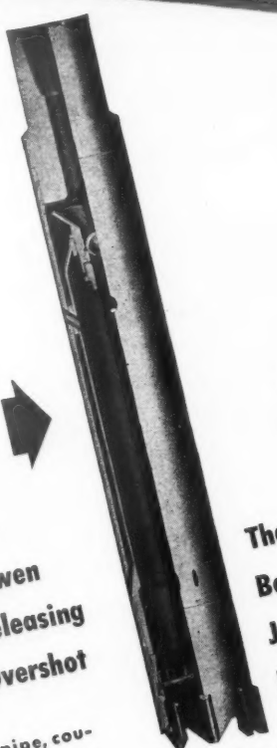

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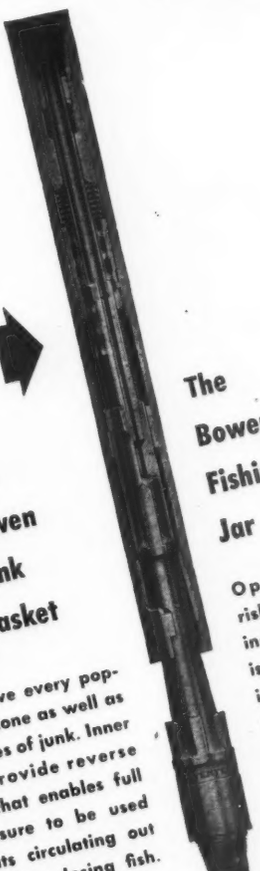

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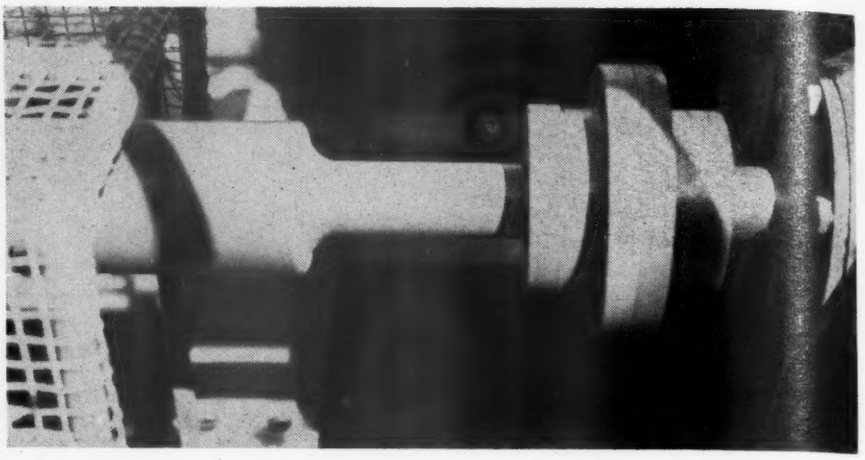
Solid shaft stubs are used in ends of tubular shafts and machined to fit Fast's couplings.



models of various kinds of drives, it was found that two wells might be pumped by connecting the pumping units with a tubular shaft. This shaft, constructed of light weight pipe similar to boiler tubes, was fitted with solid shaft stubs at each end of a diameter to match the shafting in the speed reduction gear cases on the pumping units.

The gear cases on the pumping units had a fly-wheel on the side opposite the original gas engine V-belt drive sheave. The drive shaft to operate the first two-well hook-up was built as a balanced unit to prevent damage to equipment due to whipping. Fast's self-aligning couplings were used to connect both ends of the drive shaft. One was bolted to the flywheel side of the pumping unit containing the gas engine power unit, and the other end was bolted to the end of the gear case shaft where the V-belt sheave had been installed originally. This method provided a rigid drive between the 2 adjoining pumping units, so that both began to operate when the gas engine was begun. The 2 wells selected for the initial experiment were as near 'twin' wells as any two wells might be, so as to reduce unbalanced pumping as much as possible.

The two wells were balanced as well as possible so that on the upstroke of one, the other was on the down-stroke. It was observed that the engine ran smoothly and that fuel consumption was reduced somewhat. Most of the wells on this lease have similar operating characteristics, so, after several weeks of pumping two wells with one engine, it was decided that perhaps 3 wells might be operated with only one engine by connecting 3 in a row with drive shafts.

The method of hooking up the third well was almost a duplication of the hook-up of the 2-well pumping job, but the angle of separation of the wells, in relation to the pumping strokes, was fixed at approximately 120 degrees. As the 217 cu in multi-cylinder engine* handled the pumping load with ease, several other 3-well hook-ups were made. Fuel consumption was reduced, and two of the original 3 engines were taken out of service. Maintenance of power units has been cut two-thirds, and fewer replacements and overhauls of engines appear to be necessary. * *

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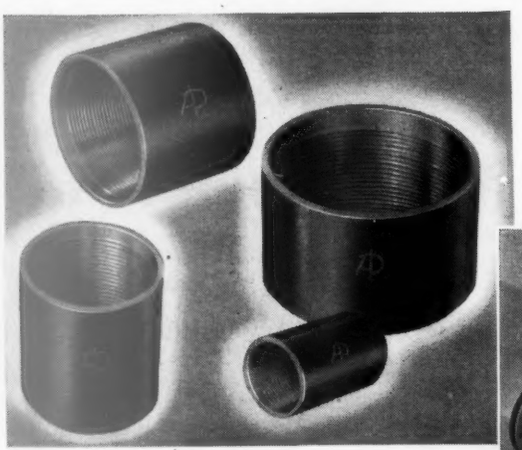

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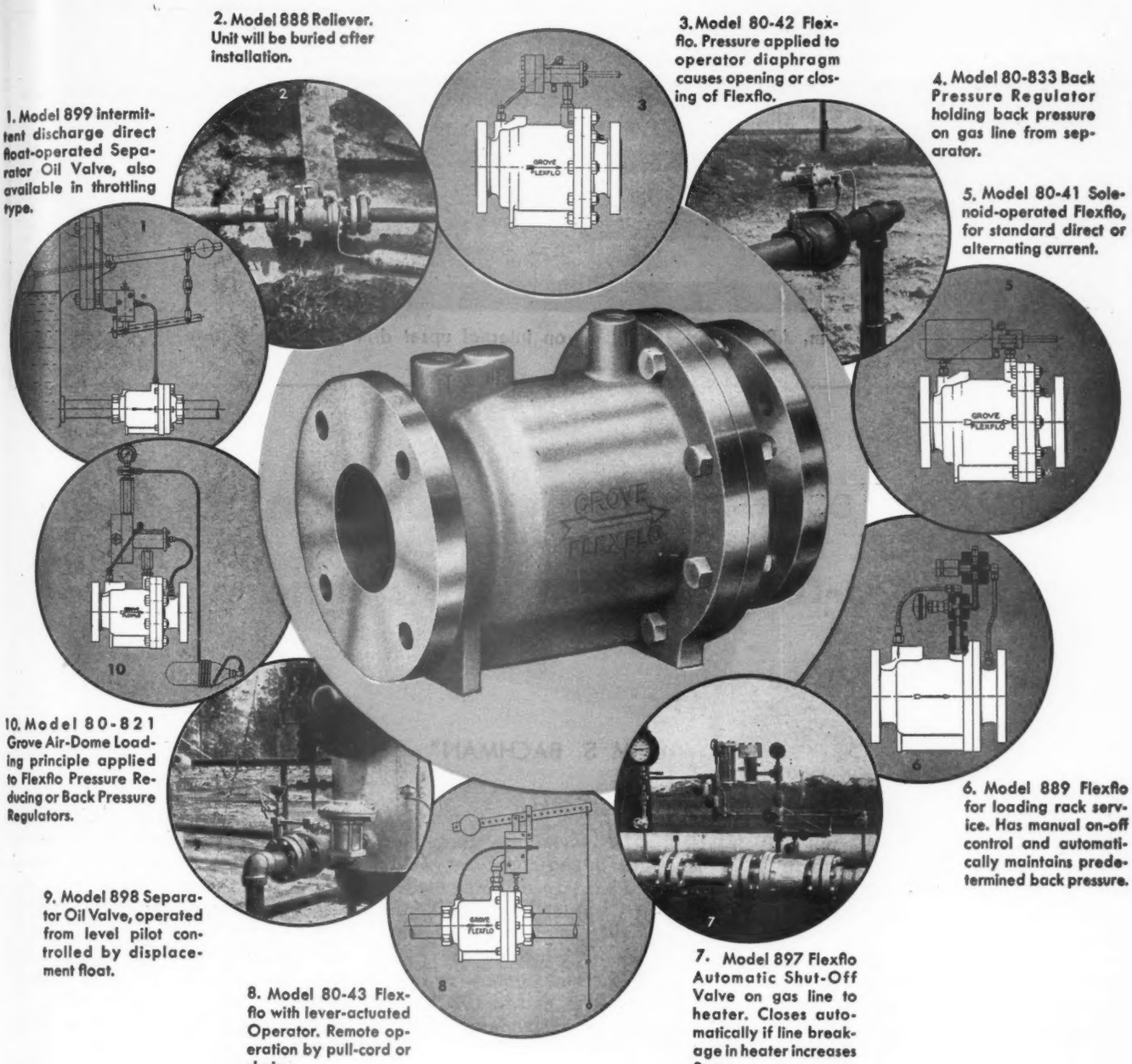

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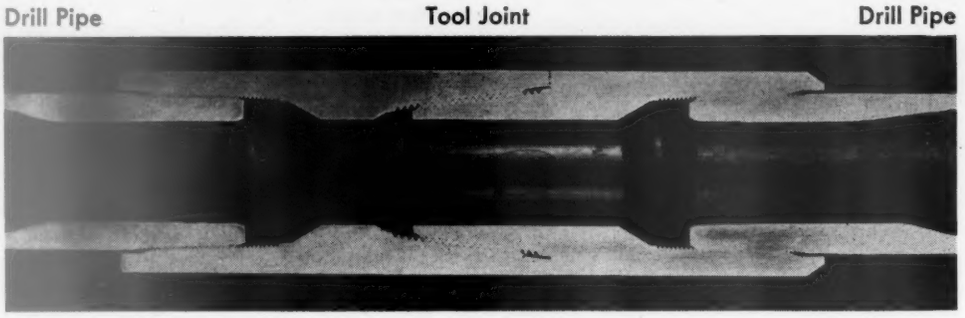

A typical grade "D" drill pipe analysis.

Carbon	.42%
Manganese	1.35%
Phosphorus	.017%
Sulfur	.019%
Silicon	.20%

FIG. 1. Cross-section of 4½-in. API tool joint installed on internal upset drill pipe.

Fatigue Testing and Development of Drill Pipe-to-Tool Joint Connections†

WILLIAM S. BACHMAN*

ONE of the major problems in the development of rotary drill stem has been to eliminate fatigue failures in service at the last point of engagement between tool joint and drill pipe. In recent years this type of failure has been reduced greatly by the use of better designed tool joints. These newer designs are the result of both laboratory and field experience.

In this paper results from fatigue tests on full size 4½ in. drill pipe connections are given. The factors that affect fatigue strength of a drill pipe connection are also discussed, and there is included a sample fatigue strength problem to demonstrate how the higher fatigue stress values of the newer type connections have almost eliminated failures at the tool joints.

Brief History

The first drill pipe was a low carbon butt-welded or lap-welded pipe with short couplings of similar material. Failures soon proved such a pipe unsatisfactory for deeper drilling, and the hot-rolled and pierced seamless tubing was introduced, made of higher carbon, higher tensile strength steel.

Because of the necessity of continually making-up and breaking-out the joints, it soon became apparent that the short fine thread couplings could neither stand hard usage nor be made-up and broken-out fast enough. Therefore, about 1910, the first heavy section tool joints were introduced. (Fig. 1). In 1918, the tool joints were first made of alloy steel, and in 1925 they were adopted as a standard by the American Petroleum Institute.

The pipe, however, proved to be weak at the threaded sections on the ends. In an effort to eliminate this weakness and subsequent failures, the pipe was upset on the ends enough to compensate for the material removed in threading. Later, because of the continued failures, the upset was eventually increased to as much as two and one-half times the thickness of the body of the pipe. (Fig. 1). Threads were also changed from sharp to rounded crests and roots in an effort to reduce stress concentration.

Last engaged thread failures in the pipe (Fig. 2) did persist in threaded API joints, however, until designs which will later be discussed were introduced.

The drill pipe which was finally developed and most commonly used in the oil field today, is known by API specifications as Grade D. It has a minimum tensile strength of 95,000 psi and yield strength of 55,000 psi. Generally, it will exceed these limits.

Causes of Last Engaged Thread Failures

Last engaged thread failures in the field are generally due to some form of bending fatigue. The bending of the pipe may be caused by crooked hole, running the pipe in compression to apply weight to the bit, slightly unbalanced sections of the pipe turning at high rpm, and general vibrations throughout the string. Each tool joint with its size larger than that of the

COMMENT

"The data on fatigue strength of full size drill pipe and tool joints presented in this paper are of especial interest to the worker on the theoretical aspects of metallic failure. These results, collected over a period of fifteen years from more than one thousand individual full-sized tests made by the Hughes Tool Company Laboratory, represent a substantial portion of the fatigue information ever published on the strength of large diameter specimens of any type. This type of information is imperative if we are ever to understand the serious question of size effect."

(Signed)

Dr. Robert Plunkett,
Mechanical Engineering Dept.,
Rice Institute.

October 18, 1950.

†Presented at the Petroleum-Mechanical Engineering Conference of The American Society of Mechanical Engineers, New Orleans, Louisiana, September 25-27, 1950.

*Research Engineering Department, Hughes Tool Company, Houston, Texas.

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FIG. 2. Typical pipe fatigue failure at the last engaged thread with API tool joint connection.

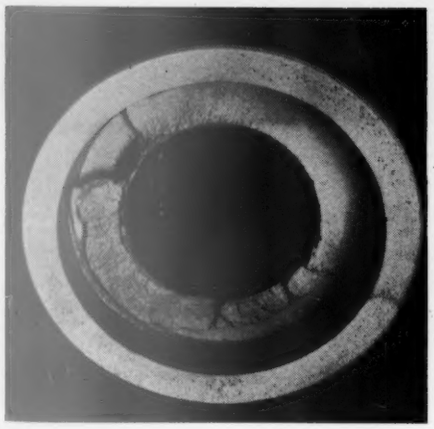

FIG. 3. Fatigue test machine for full size drill pipe specimens.

adjacent pipe acts as an excellent mass concentration to set up transverse vibrations. In addition to bending, the joint is also subjected to torsion and superimposed on both is tension or compression. This combined load is applied on the last engaged thread which acts as a notch, and the notch creates a stress concentration point. The notch will materially reduce the fatigue failure stress below its value for the normal wall section without threads.

The failure stress is difficult to calculate mathematically and generally full size tests are necessary to accurately determine the fatigue strength of a connection.

Method of Fatigue Testing

In order to duplicate in the laboratory the bending fatigue type loading of drill stem in the field, the large rotating-beam fatigue test machine shown in Fig. 3 is used. This machine consists of a spindle for holding a ten foot section of drill pipe with tool joint installed, a motor for turning the spindle at 300 rpm, and a weighted member mounted on roller bearings at the end of the pipe opposite the spindle to apply the bending load.

The rotation of the pipe under load subjects the member to completely reversed bending stresses. It is believed that this type of stressing is a reliable criterion from which the relative values of fatigue failure strength could be obtained for various designs of tool joint connections.

For most test work a tool joint is installed on a piece of drill pipe with an upset end and in practically all cases using the newer type joints a break will occur in the body of the pipe before it fails at the tool joint. This information is usually sufficient —that is, the connection is stronger than the body of the pipe. When it is desirable to compare various types of joint construction, however, it is necessary to use special thick section pipe the same length as the regular drill pipe test section to insure failure at the tool joint.

FIG. 4A. Typical failure in body of drill pipe.

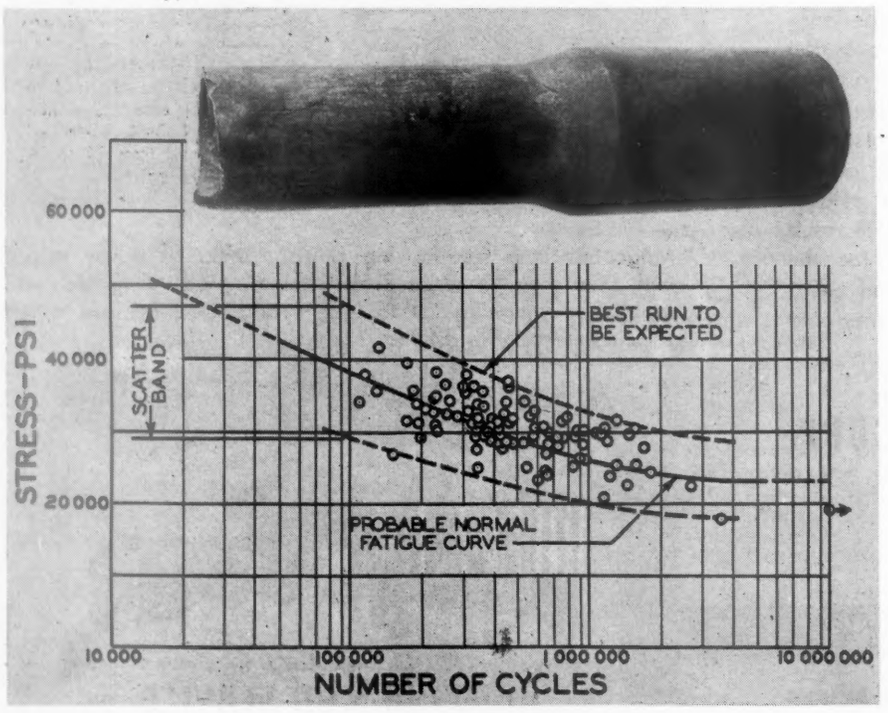

FIG. 4B. Fatigue failure in body of 4½-in. drill pipe.

Factors Affecting Fatigue Results

The following is a brief outline of several factors that affect fatigue results obtained from tests on drill pipe specimens:

A. *Surface Conditions.* Any irregularities on the surface of the pipe act as tiny stress raisers, forming nuclei from which fatigue cracks can propagate. Small pits, tong and slip marks, hammer peening dents, steel stencil letter marks, or any number of other marks may be found on drill pipe in use. Hence drill pipe will have a lower fatigue strength than comparable tubular laboratory specimens of the same size which have machined and polished surfaces.

B. *Notches.* In the case of the machined thread sections at the end of the pipe, the many small surface discontinuities are reduced by machining, however, when a notch in the form of a thread is introduced, this acts as an even greater stress raiser than the small pits in the body of the pipe.

Different steels react differently to notches. This is known as the notch sensitivity of a steel. As a general rule,

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FIG. 5A. API threaded connection.

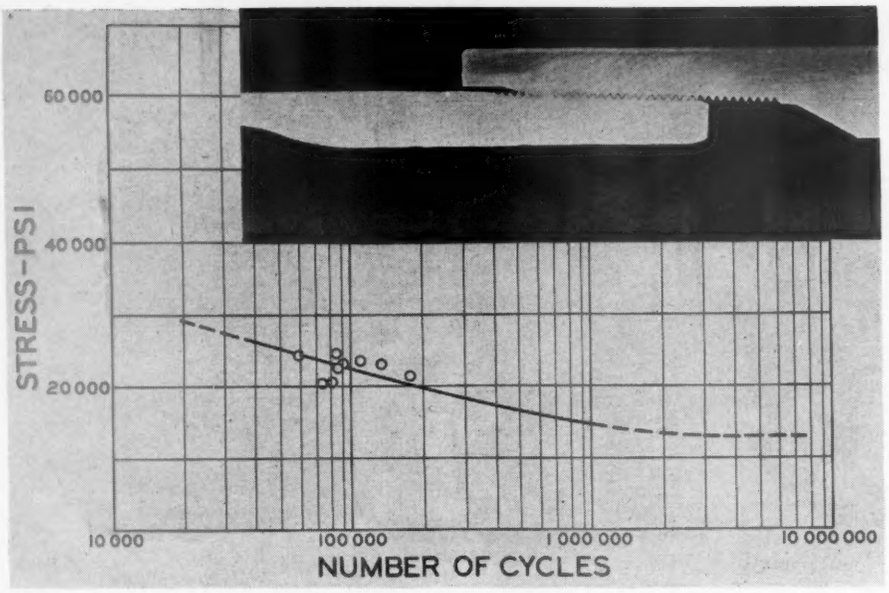

FIG. 5B. Fatigue curve failures at last engaged pipe thread.

in the absence of corrosion or stress raisers such as notches, polished specimens of heat treated alloy or high carbon steel have a higher fatigue strength than the lower tensile strength steels. When a notch is introduced, however, the higher tensile strength steels are affected to a greater degree than the lower strength steels. To illustrate this fact, it was found on a number of actual tests on 4½ in. diam SAE 3140 heat treated alloy steel specimens that the fatigue failure stress is reduced from 30,000 psi for the unnotched sections to 10,000 psi for the notched or threaded sections. In the case of the medium carbon steel in drill pipe, the reduction in the fatigue failure stress was only from 27,000 psi for un-notched to 15,000 psi for notched sections. Therefore, the steel in the drill pipe is not as notch sensitive as the alloy steel in the tool joint.

C. *Change in Section and Clamping Stresses.* In the case of some designs where the pipe is supported in the counterbore by a section outside of the last engaged thread (Fig. 7A), there is a natural stress raiser at the end due to the change in section known as the "square shoulder effect." This effect is not as great a stress raiser, however, as the notch effect of a thread.

Theory would seem to indicate that the clamping stress produced in the pipe by a shrink-type joint (Fig. 10A), utilizing a tightly shrunk-on land at the pipe-end of the joint, might affect the fatigue strength. To date this effect has not shown up on test specimens, however. The stress raiser due to the "square shoulder effect" produced by the end of the joint is apparently greater than the clamping effect of the joint, and apparently the two stress raisers are not additive.

To demonstrate this, consider the welded construction of Fig. 7A where there is a square shoulder and no clamping, and the shrink-type construction of Fig. 10A where there is a square shoulder plus clamping. Both joints have a fatigue failure stress of 20,000 psi. To insure that there was no additional stress raiser caused by welding of the material at the shoulder, several tests were run on joints of pipe with large external upsets machined to form square shoulders directly in the pipe steel. These special square shoulder joints with no weld and no clamping stress still indicated a fatigue failure stress of 20,000 psi.

D. *Corrosion Fatigue.* In the field, probably the greatest number of fatigue failures of pipe can be attributed to conditions resulting from corrosion. In the presence of a corrosive medium in the drilling mud, the pipe and connections in use under stress are quickly attacked by corrosion, and cracks and pits form on the surface layers. The problems in every corrosive area are different, and thereby hard to duplicate in laboratory tests.

Time, temperature, corrosive medium, and the type of steel are the four factors present in any corrosion-fatigue problem. In order to make testing feasible in the laboratory, corrosion is accelerated, the time element is greatly reduced, and the activeness of the corrosive fluid is increased. When these various changes from actual field conditions are made, the fatigue results obtained to date on full size drill pipe are not too reliable. The test results given in this paper are on non-corroded specimens, however, in any tool joint design corrosion should be considered.

There is no endurance limit in a corrosion fatigue test. Time keeps changing conditions of the pipe. In-

FIG. 6A. Vanishing thread connections.

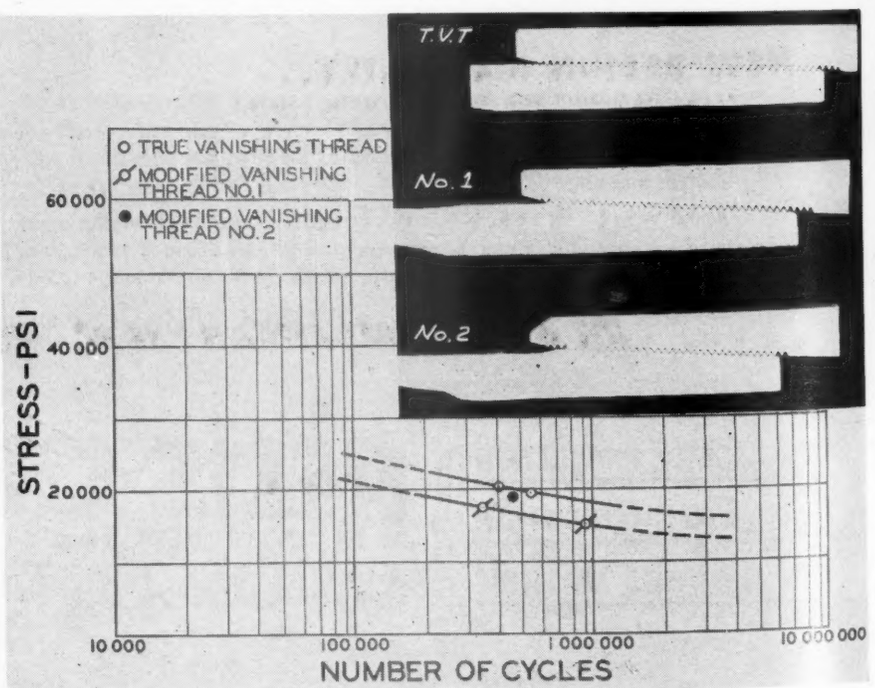

FIG. 6B. Fatigue curves—failures at last engaged pipe thread.

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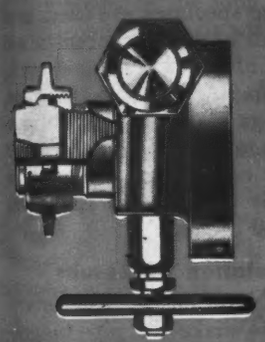

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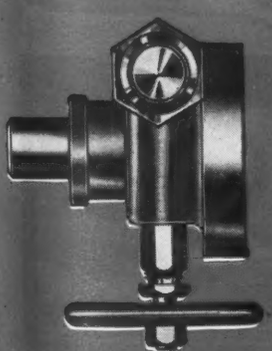

Type "JE"-2 Flow Control

Type "JE"-3 Flow Control

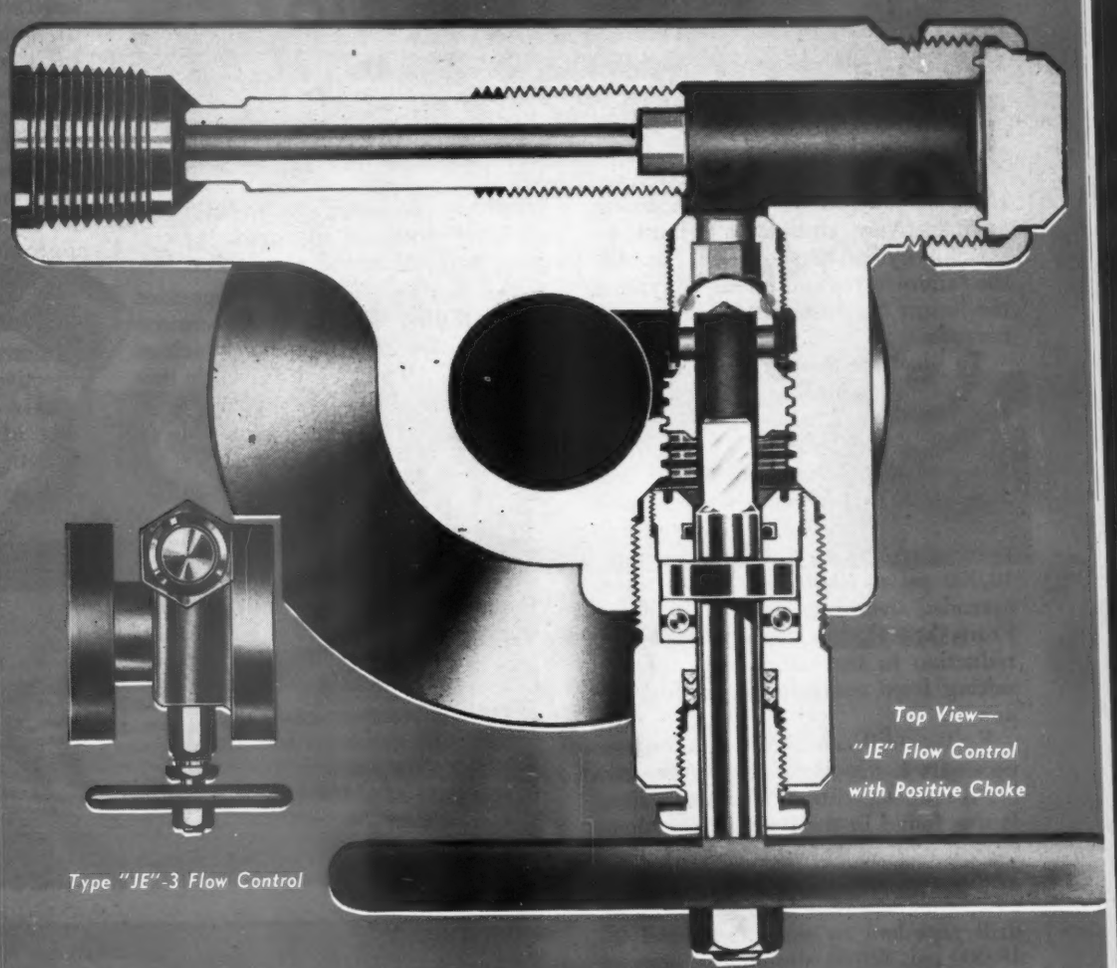

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FIG. 7A. API threaded connection with welded pipe end.

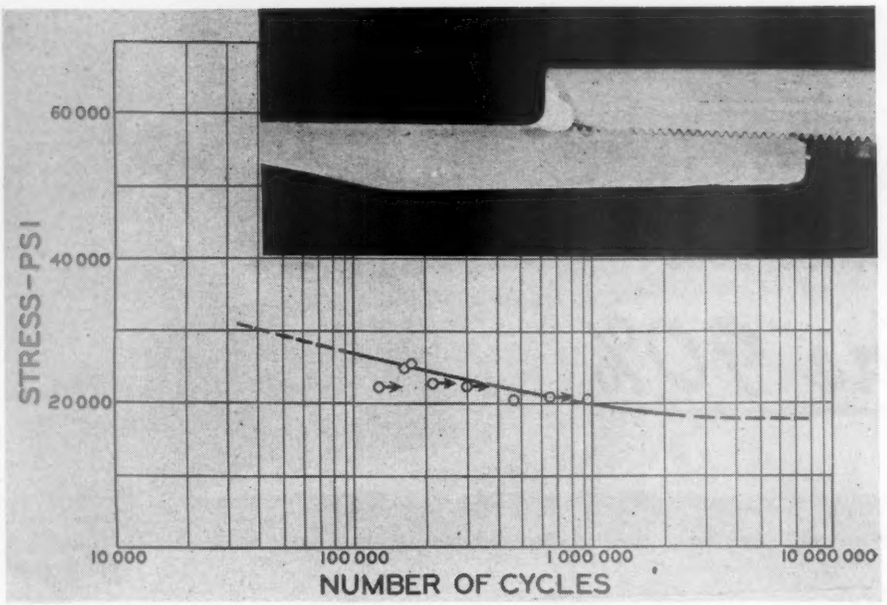

FIG. 7B. Fatigue curve—Failures in pipe at tool joint shoulder.

stead of the fatigue curve becoming comparatively straight at about 4,000,000 cycles as shown in Fig. 4B, the failure stress continually decreases the longer the specimen is allowed to corrode.

To illustrate this, Fig. 4B indicates the normal endurance limit of Grade D 16.60 lb per ft drill pipe to be 24,000 psi at 10,000,000 cycles. R. C. Bowden[1] of the National Tube Company states that from tests they found that Grade D drill pipe has a corrosive endurance limit of approximately 10,000 psi at 10,000,000 cycles when corroded over a period of 40 days. From these figures the high degree of reduction in the fatigue strength resulting from corrosion is readily apparent.

E. *Size Effect.* The fatigue stress necessary to produce failure of a member is reduced with an increase in size. It was found in the Battelle investigation of drill pipe failures[2] that ⅜-in. machined specimens made of a steel comparable to that used in Grade D drill pipe had an endurance limit of 48,000 psi. When compared to a normal endurance limit of 24,000 psi on full size 4½ in. drill pipe, the effect of size is apparent even though surface conditions were different.

Size, causing differences in fatigue strength, is considered by some authorities to be a result of the greater amount of material present, and hence, there is more chance of a stress raiser being present to form the nucleus of a fatigue crack. If the crack starts, the remaining material is progressively subjected to an ever increasing stress as the crack propagates, and failure will soon occur.

The fact that size is so important makes testing of full size specimens very helpful in comparing various structures. All test results given in this paper are restricted to 4½ in. drill pipe to try to eliminate the variable of size effect in the discussion.

[1]See No. 9 in Bibliography.
[2]See No. 7 in Bibliography.

S-N Curves

In order to interpret these fatigue results, a conventional S-N (stress-no. cycles) or endurance limit curve is plotted on semi-log paper. (Fig. 4B). All points on this chart are actual failures at a given section of the test specimens except those points with arrows attached. The arrow indicates that the section in question had not failed at the time the test was stopped.

The endurance limit for steel, the highest stress at which a specimen will run indefinitely without failure, can usually be determined in 4,000,000 to 10,000,000 cycles. In this paper, the failure stress at 1,000,000 cycles is used for comparison and will be slightly higher than the endurance limit. This practice is believed to be satisfactory in determining relative strengths where the same type of steel and same size specimen are used, and only the form of stress concentration at the point of failure changed such, as notches, shoulders, etc. In this case, the percentage difference in fatigue stress values on the S-N curves for two different constructions should be approximately the same at 1,000,000 and 4,000,000 cycles.

Interpretation of Results

In any tool joint design the primary objective is to make the pipe-to-tool-joint connection stronger than the body of the pipe, in order that the strength of the entire string will be

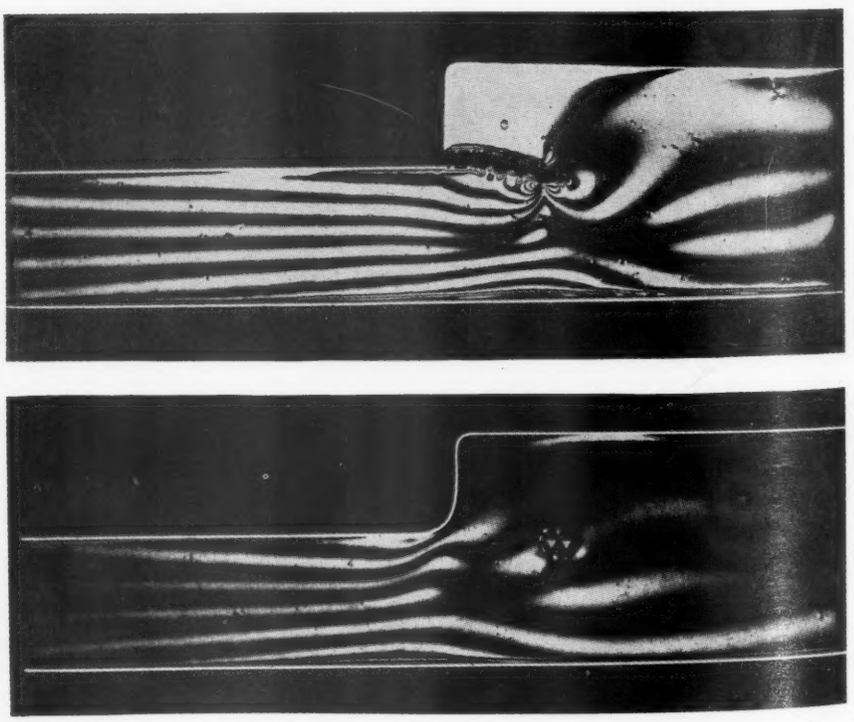

FIG. 8. Photo-elastic study of stress concentration at last engaged thread.
The top view shows the stress concentration present at the last engaged thread in an API connection. The lower view demonstrates the reduction of stress concentration by the addition of a welded band adjacent to the last engaged thread.

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The fatigue strength of any section of pipe is determined by the bending moment necessary to produce failure. The bending moment is calculated from the simple flexure formula:

(Bending Moment = Fatigue Failure Stress × Section Modulus).

The body of the pipe has a high fatigue failure stress and a low section modulus. The pipe at the tool joint connection has a lower fatigue stress, but a higher section modulus because of the pipe upset. The problem has been to design a connection in which the product of fatigue failure stress and section modulus is higher at the tool joint than in the body of the pipe.

Better designs having less concentrated stress at the connection have accounted for most of the increase in the fatigue strength of the new type connections. The pipe upset has been increased only slightly, if any. Larger upsets are undesirable because the original cost is increased and hydraulic efficiency is decreased.

Fatigue Strength of Body of Drill Pipe

The drill pipe scatter band, representing the difference in fatigue strength between the best and the worst specimens, is wide. (Fig. 4B). In addition to surface pits and mill scale causing scatter, the hardness of the test specimens would also be a contributing factor.

Referring to Fig. 4B, "Fatigue Failures in Body of Drill Pipe," there are two significant fatigue curves shown: (1) the normal fatigue curve, and (2) the "best run to be expected" curve.

To eliminate the possibility of an occasional piece of pipe being stronger in the body than at the tool joint connection, the connection is designed stronger than the best pipe specimens represented by the "best run to be expected" curve. This design value at 1,000,000 cycles would be approximately 32,500 psi for 4½ in. Grade D 16.60 lb per ft drill pipe. The normal fatigue curve, representing an average specimen, would indicate a stress necessary to produce failure of only 27,000 psi at 1,000,000 cycles.

Fatigue Data on Tool Joints

Tool joints may be classified according to their pipe connections as follows:

A. Threaded pipe-end connections.

B. Threaded pipe-end connections with welded end adjacent to threaded section.

C. Threaded pipe-end connections with supporting land adjacent to the threaded section.

D. Welded-on or unitized connections.

E. Other types.

Fatigue tests are available on at least one or more types under each of these general headings and should be sufficient to indicate what might be expected of most designs.

A. *Threaded Pipe-End Connections.*

1. Regular API Threaded Connection (Fig. 5A).

The failures shown on Fig. 5B occurred in the pipe at the last engaged thread. In this particular construction failures will generally occur at this point rather than in the body of the pipe. Most of the tests failed in the vicinity of 100,000 cycles. By extrapolation, using the general form of other curves of this size section that have failed on longer runs, a reasonable stress value for the normal fatigue curve at 1,000,000 cycles is 15,000 psi.

2. Vanishing Thread Connections (Fig. 6A). There have been several

FIG. 9A. Bucked-on threaded connection with supporting land outside of last engaged pipe thread.

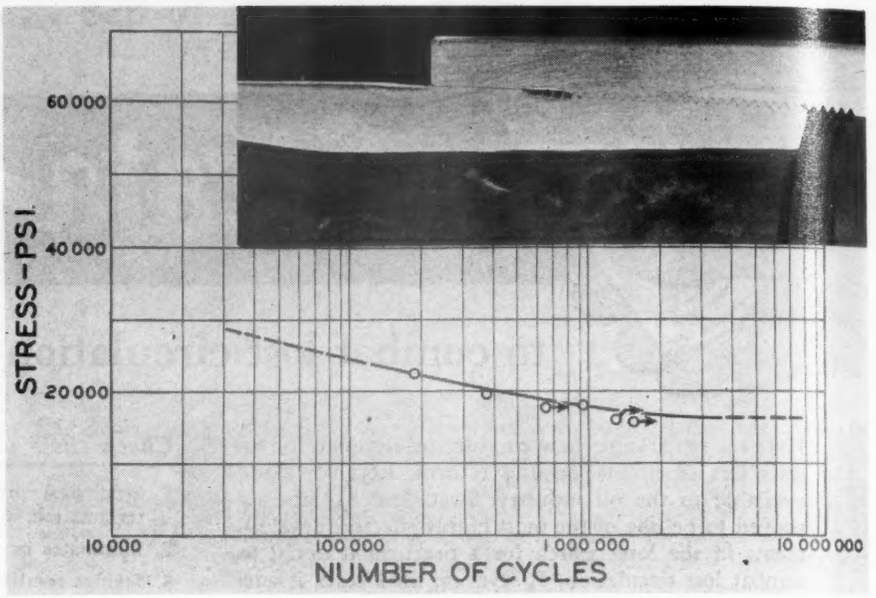

FIG. 9B. Failures in pipe at tool joint shoulder.

FIG. 10A. Shrink type threaded connection with supporting land outside of last engaged pipe thread.

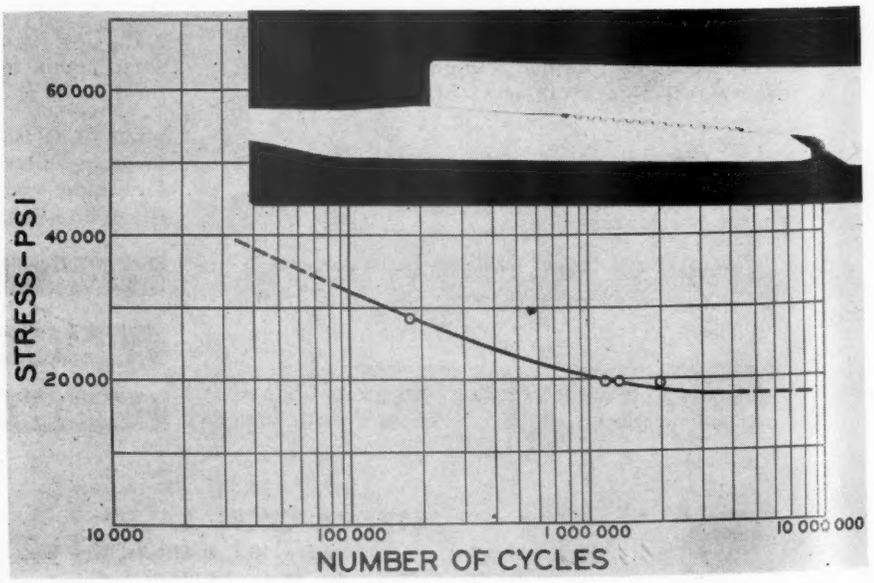

FIG. 10B. Failures in pipe at tool joint shoulder.

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FIG. 11A. Hand-weld connection.

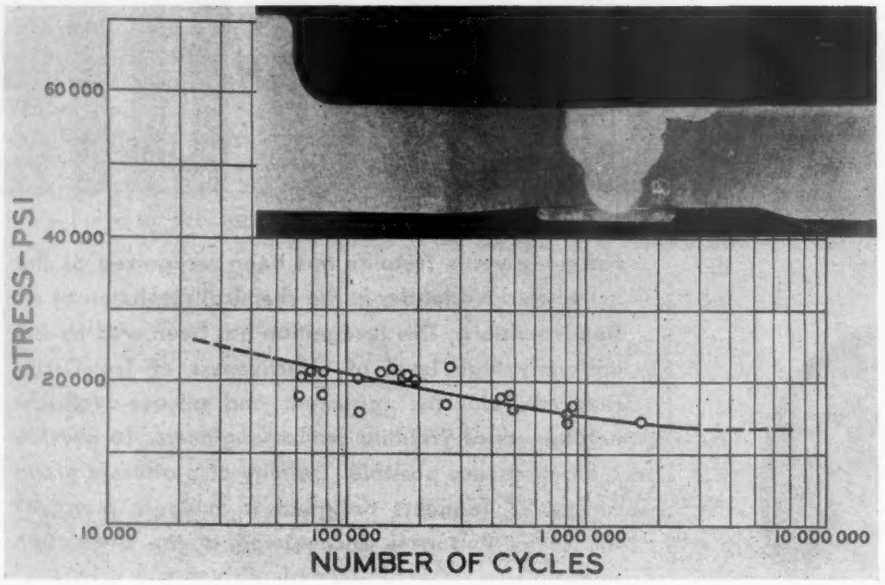

FIG. 11B. Fatigue curve—failures in weld.

Fig. 6A are the true vanishing thread and the modified types that utilize a thread relief at the last engaged thread.

Of the types shown, the true vanishing thread has the highest fatigue stress. On Fig. 6B the few scattered tests available indicate the pipe would fail at the last engaged thread at a stress of 15,000 to 19,000 psi at 1,000,000 cycles; however, there are not enough tests on any one type to try to establish a definite fatigue limit.

attempts to reduce the notch effect present in the API connection by using the various types of vanishing thread designs. The designs shown in

B. *Threaded Pipe-End Connections with Welded End.*

1. Regular API Connections with Welded End.

Drilling contractors in the field first began the practice of welding the ends of the tool joints to the pipe. The first welds were built-up bands of metal 1 to 2 in. long at the ends of the joints. This was often done by using a copper sleeve around the end of the joint and filling the space between sleeve and pipe with a band of metal.

Following these field welded joints, the present welded type was developed in which two beads are welded in the counterbore at the end of the tool joint and the shoulder machined after welding. (Fig. 7A). This is presently known as a counterbore weld tool joint.

The weld provides support for the pipe at the end of tool joint reducing stress concentration at the last engaged thread. The last engagement between pipe and tool joint then becomes a square shoulder over a heavier part of the tapered pipe upset instead of a thread cut in a thinner portion of the upset. The weld also acts as a seal to prevent corrosive mud from contacting the threads.

The normal fatigue failure stress for the section of the pipe adjacent to the shoulder and weld is 20,000 psi at 1,000,000 cycles. (Fig. 7B).

To illustrate the reduction in stress concentration provided by the welded support outside the last engaged thread, Fig. 8 shows an actual photoelastic study of a regular API connection and a counterbore weld joint with a solid section outside the last engaged thread. In this study both joints are loaded with approximately the same bending moment, and the degree of stress concentration is indicated by the number of lines present at any section. Comparison of the two photographs shows the notch effect at the last engaged thread has been practically eliminated in the weld-type joint.

C. *Threaded Pipe End Connection with Supporting Land Adjacent to the Threaded Section.*

These joints are classified as the bucked-on and shrink types (Figs. 9A and 10A). It should be noted that the thread form is different in each case. The bucked-on joint is screwed on the pipe using a torsional load while the shrink type joint is heated, screwed-on, and on cooling, shrinks until both threads and land tightly engage the pipe. The bucked-on joint utilizes a regular 60 API "V" pipe thread. The shrink type has a modified acme thread which provides clearances on the thread flanks. These clearances are necessary to allow for longitudinal shrinkage and to prevent excessive interference between the mating threads in the hot and cold positions.

1. Bucked-On Type (Fig. 9A).

For the best performance it is necessary to buck the joint on the pipe using a buck-up machine where a controlled amount of torque can be applied. The bucked-on joint is not readily removable, like the shrink type joint, because it will sometimes gall when bucked-off the pipe. The bucked-on type represents an increase in fatigue strength over the regular API joint and protection of the last engaged thread against corrosion.

FIG. 12A. Flashweld connection.

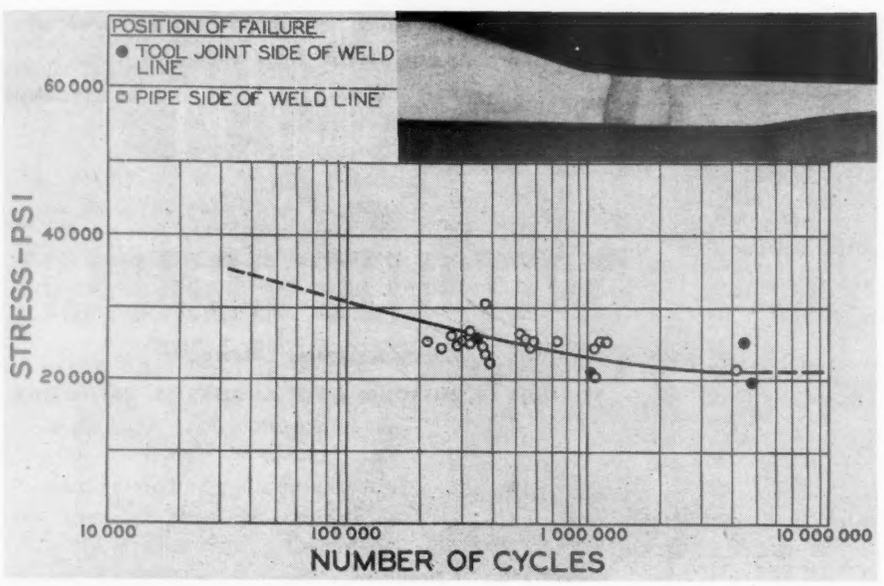

FIG. 12B. Fatigue curve—failures in upset adjacent to weld line.

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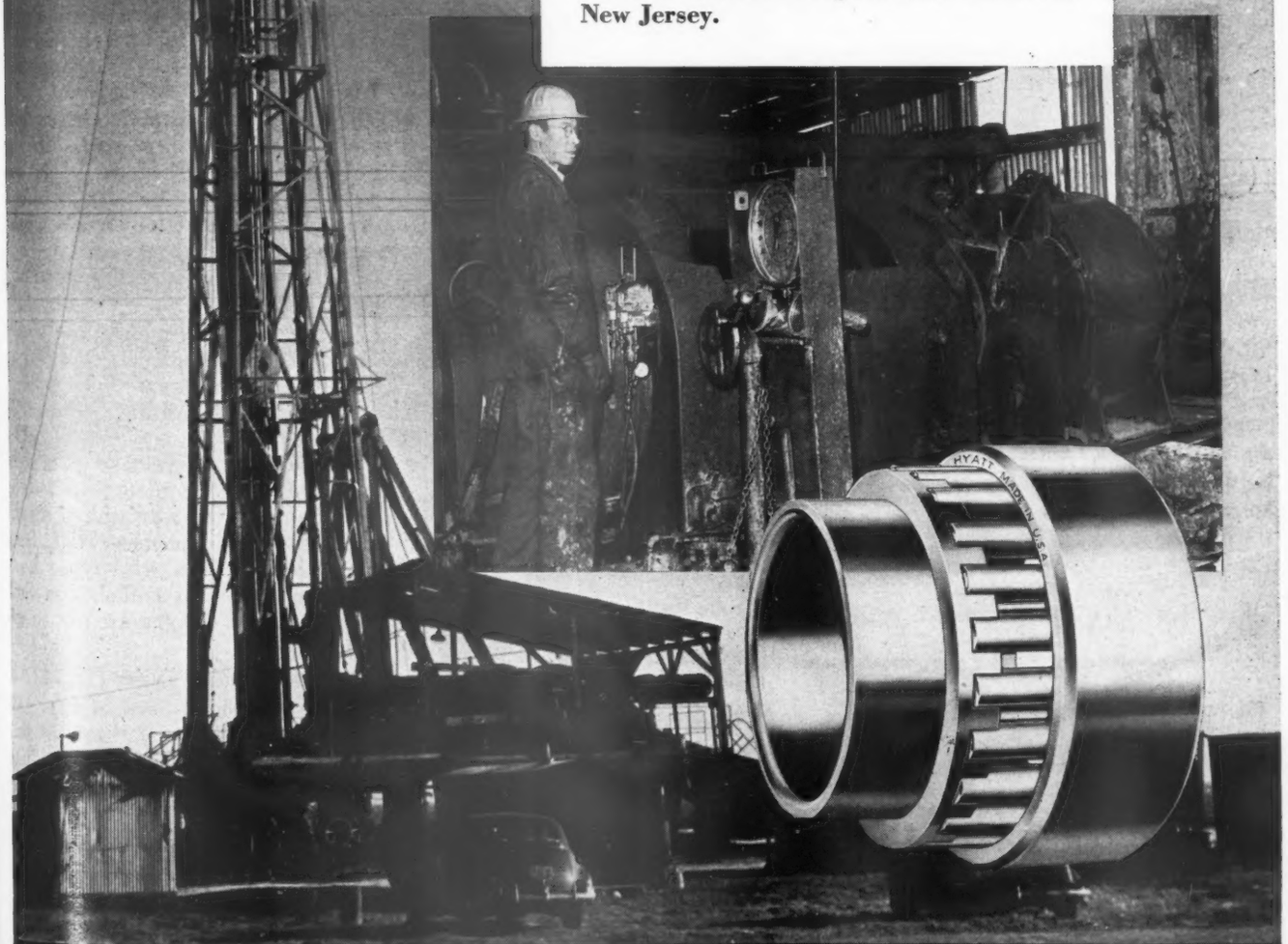

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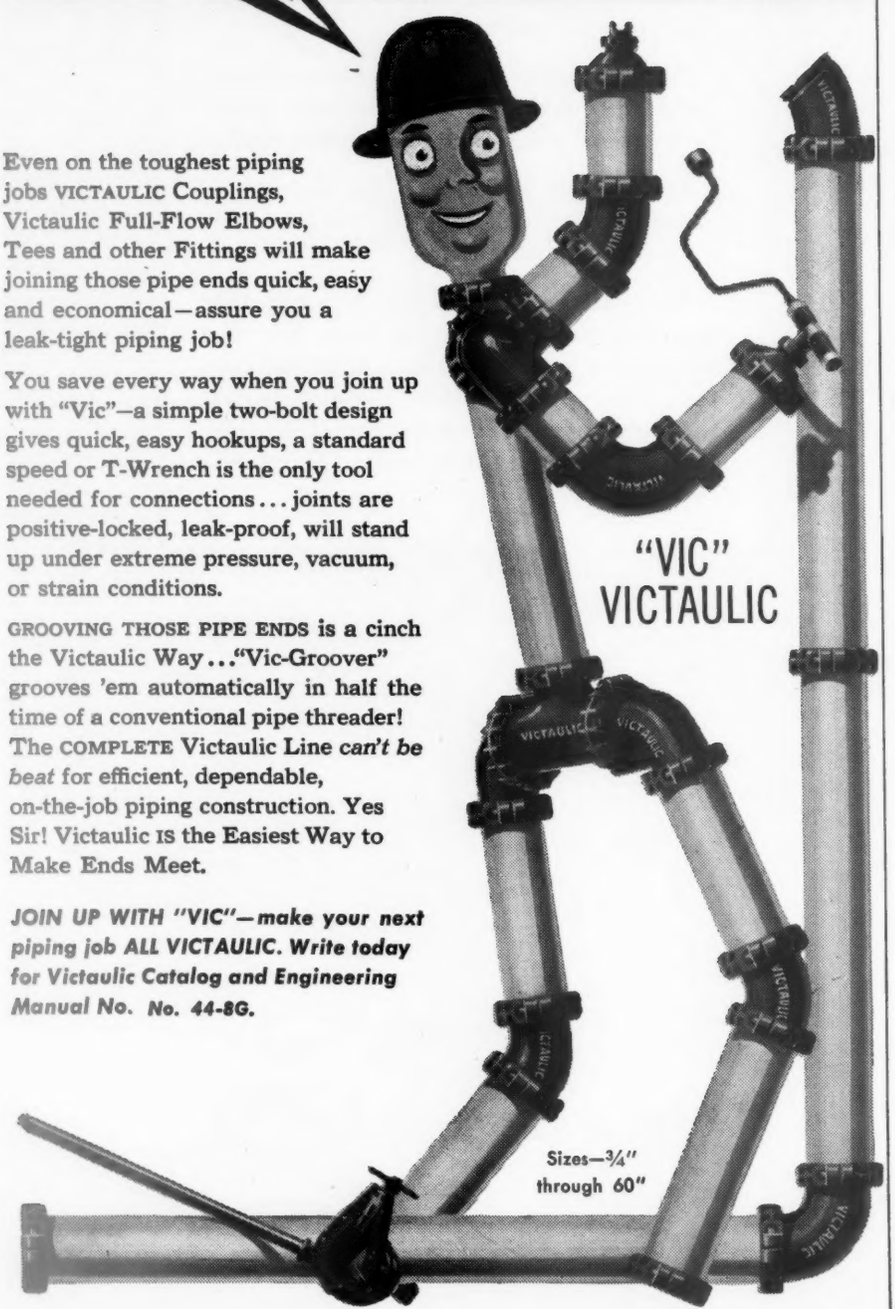

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As shown on Fig. 9B, the tests available on the bucked-on connection indicate that the pipe at the tool joint shoulder has a fatigue failure stress of 18,000 psi at 1,000,000 cycles.

2. Shrink Type (Fig. 10A).

This type joint supports the pipe against bending in a similar manner to the bucked-on type, and the last engaged thread is sealed against corrosion. The shrink-on joint has the additional advantage of being removable by heating the joint and quenching the pipe.

A tight fit is assured on the supporting land by designing the correct amount of interference between joint and pipe and heating to the proper temperature on installation. The interference between joint and pipe can be greater than in the case of the bucked-on type without the danger of galling the threads or lands when the joint is screwed on the pipe. This eliminates the possibility present in the bucked-on type of slight gall on the threads or land, produced during make-up, causing a local high spot between pipe and joint. Such a joint would appear to be tight on installation but might loosen in service.

The test results available, shown on Fig. 10B, indicate that the shrink type has a fatigue stress of 20,000 psi at 1,000,000 cycles at the tool joint shoulder which is slightly higher than the 18,000 psi failure stress on the bucked-on type. If both joints are equally tight at the shoulder, however, the stress concentration should be the same, and this difference may be a result of scatter.

D. *Welded-on or Unitized Tool Joints.*

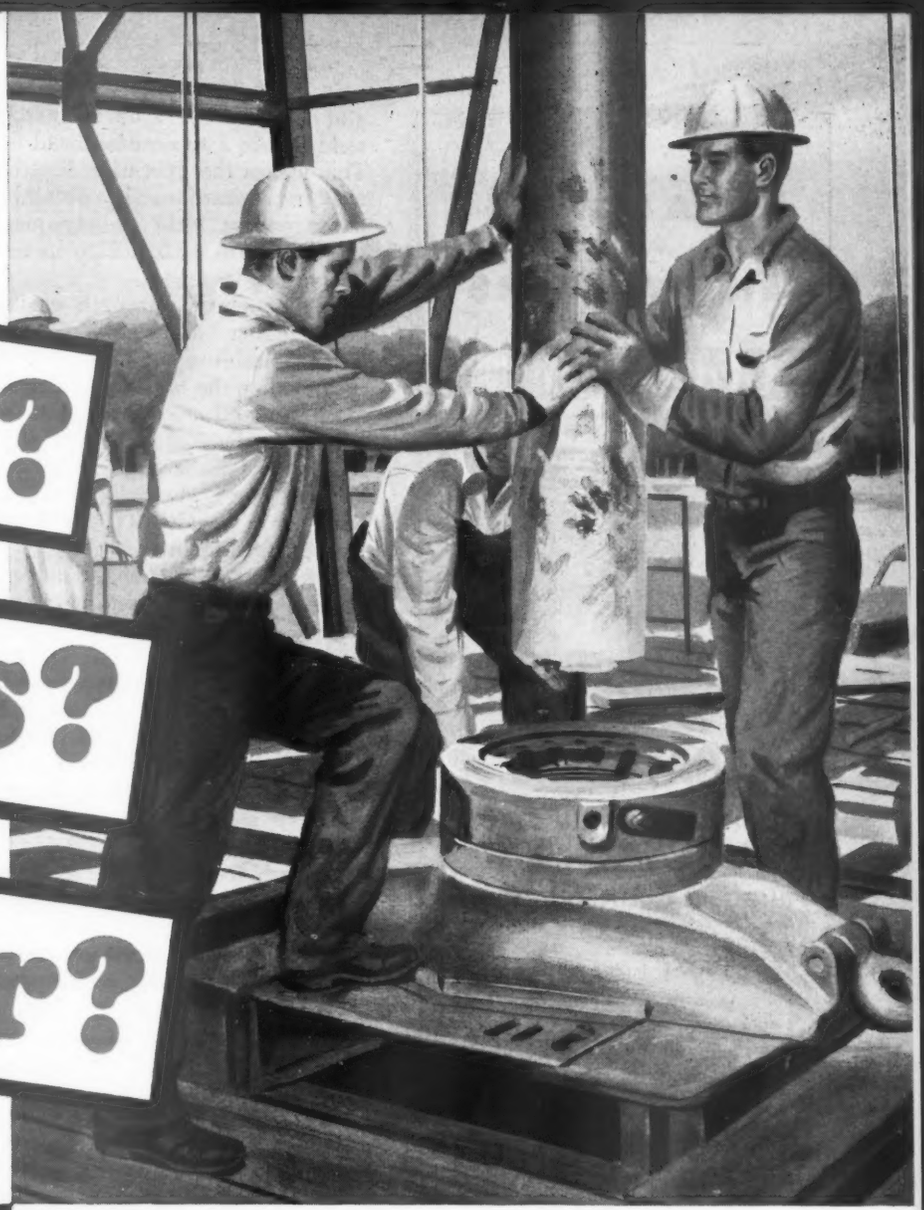
In an effort to eliminate a threaded pipe-end connection and still have the physical properties of an alloy steel joint, many attempts have been made to weld the tool joints to the drill pipe.

The problem has been to get a weld consistently strong enough in fatigue strength to eliminate failures at the weld line. This problem has been solved by the flash weld type; however, the test results available on various hand weld designs are not so encouraging.

1. Hand Welded Types (Fig. 11A).

The test results given in Fig. 11B are for the failures at the weld line and have been derived from more than a half-dozen different designs. These include electric-arc welds as well as acetylene welds. The arc-welded types develop slightly higher fatigue strength values. The joint as shown in Fig. 11A is typical of one of the designs tested.

In order to build up a hand weld, it is necessary to run successive beads around the joint, carefully chipping



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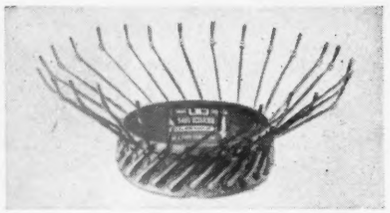

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and cleaning scale from the preceding weld before a succeeding bead is run. This makes the operation lengthy, as well as hazardous in obtaining a homogeneous weld as any piece of slag will form an inclusion in the following bead.

Higher tensile strength electrodes give a higher fatigue strength on hand welds. Building up the last bead greater than the outside diameter, and machining off excess metal to clean up the surface of the joint will increase the fatigue strength. A copper back-up ring is generally used to eliminate the possibility of burning through to the bore of the joint.

Fig. 11A indicates that hand welded joints can be expected to have fatigue failure stress of 15,000 psi at 1,000,000 cycles at the weld line. The scatter band for any of the types of hand welded construction is so wide, however, that the reliability of this figure is questionable. For this reason, there have been no attempts made in this paper to separate the various hand welded types.

2. Flash Weld Type (Fig. 12A).

In principle flash welding consists of melting two pieces of metal by electric arcing, at the point at which the weld is to be made, and squeezing these two pieces together in the molten state.

In the case of flash welded tool joints, the joint and pipe are held in alignment in a flash welding machine and a high current applied. This causes arcing across the ends of the tool joint and pipe and subsequent melting of the metal in this area. The current is then stopped, and the joint and pipe are forced together thus squeezing out the excess molten metal at the weld line. The metal squeezed out is machined off to clean up the welded section.

In fatigue testing flash joints, where the test is set up to produce failures at the joints, the failures will always occur in the upset area adjacent to the weld line, but never actually in the weld. As illustrated by Fig. 13A, the area on either side of the weld line has a slightly lower tensile strength than the weld line itself. This probably accounts for the higher fatigue strength on the weld line.

Fig. 12B shows that the upset area adjacent to the weld has a fatigue failure stress of 23,000 psi at 1,000,000 cycles. This is a higher fatigue failure stress than obtained on any of the other types of connections tested.

Another interesting observation

FIG. 13A. Tensile strength gradient in weld zone and diagram of 60 deg "V" notch in a flashweld connection.

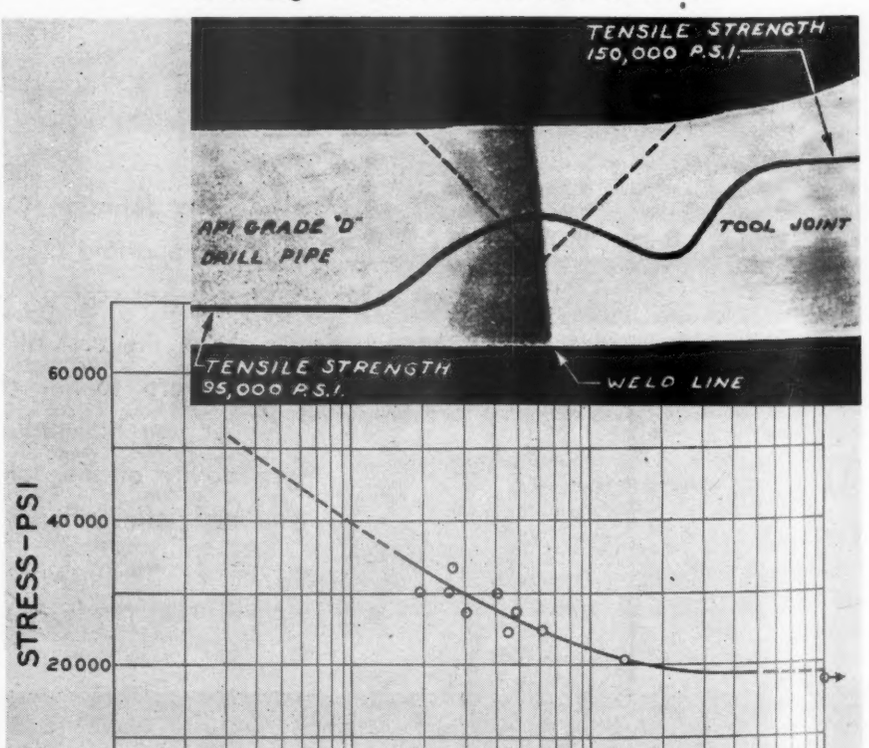

FIG. 13B. Flashweld connection failures in 60 deg "V" notch at weld line.

from the data available shows that the fatigue stress is approximately the same, regardless of whether the failure is in the pipe or tool joint side of the weld, even though one material is medium carbon steel, and the other is an alloy steel.

In order to get some idea of the magnitude of the strength of the connection at the weld line, a series of tests were run with a stress-raiser introduced to make the connection break at this point. The stress-raiser used was a sharp 60 deg notch, 3/4 in. deep, machined in a heavy section weld. (Fig. 13A). With such a notch, Fig. 13B shows fatigue strength at the weld line was still 22,000 psi at 1,000,000 cycles.

This fatigue stress indicates that the actual weld line is as strong as any other sections of the joint, even if a severe stress-raiser is present.

E. *Other Types of Tool Joint Connections.* The other general types of tool joints commercially available today, are the pressure-weld joints, similar in appearance to the flash weld type, and the integral joints with pin and box threads machined directly in heavy upsets on the ends of the pipe. The writer does not have fatigue data available on these types at the present time.

TABLE 1. Summary of fatigue results*.

A summary of the foregoing fatigue values for pipe-to-tool joint connections at 1,000,000 cycles is as follows:

Item	Nominal stress for "Normal fatigue curve" —psi
Regular API Threaded Connection—Failure of pipe at last engaged thread	15,000
Vanishing Thread Types—Failure of pipe at last engaged thread	15,000–19,000
Regular API Threaded Connection with Welded end—Failure of pipe at tool joint shoulder	20,000
Threaded Connection with Supporting Land adjacent to Threaded Section—Failure in pipe at tool joint shoulder.	
Bucked on Type	18,000
Shrink-Type	20,000
Hand Welded Joints—Acetylene and Arc-welded—Failures in weld	15,000
Flash Welded Joints—	
Failures in upset adjacent to weld	23,000
Failures in weld line with 60° "V" notch	22,000

*It should be remembered in using this table that the bending moment determines the strength of the joint, not the fatigue failure stress alone. Although the connections have a lower fatigue stress than the body of the pipe, most of the joints are actually stronger than the pipe, because of the additional section in the pipe upset.

From the stress data in Table 1 and the pipe upset proportions of 4½ in. API Grade D 16.60 lb-ft internal upset drill pipe, it is interesting to determine why the API joints would many times fail in preference to the body of the pipe while the newer type joints proved satisfactory.

Table 2 shows a series of examples of bending strength calculations using the section modulus at point of failure and the nominal bending fatigue failure stress ($BM = S \times SM$).

TABLE 2. Sample problems*.

I. Pipe strength
- BM_1 = 27,000 x 4.25 ..... = 115,000 lb-in. (Normal fatigue limit)
- BM_2 = 32,500 x 4.25 ..... = 138,000 lb-in. (Best run to be expected)

II. Connection strength
1. API Standard: BM = 15,000 x 6.65 ..... = 99,700 lb-in.
2. Vanishing thread designs: BM = 15,000 x 7.20 ..... = 108,000 lb-in.; BM = 19,000 x 7.20 ..... = 137,000 lb-in.
3. Counterbore weld: BM = 20,000 x 7.47 ..... = 149,000 lb-in.
4. Bucked-on threaded connection with land: BM = 18,000 x 7.87 ..... = 142,000 lb-in.
5. Shrink-on threaded connection with land: BM = 20,000 x 8.11 ..... = 162,500 lb-in.
6. Hand welded: BM = 15,000 x 7.98 ..... = 120,000 lb-in.
7. Flashweld: BM = 23,000 x 7.98 ..... = 184,000 lb-in.

*The section moduli in TABLE 2 are average minimum values for pipe ends used by one manufacturer. The value may vary slightly with different manufacturers using special pipe upsets, but generally these values agree with most constructions.

These figures demonstrate how the newer type tool joint connection has been made stronger than the body of the pipe, even considering the best run to be expected of the pipe. The general pipe upset proportions of the regular API joint have been maintained on most of the newer type structures and the increase in connection strength is a result of the use of better designs.

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Acknowledgment

The tests outlined in this article were made in the Engineering Laboratories of the Hughes Tool Company in Houston, Texas. The author would like to gratefully acknowledge the work of Seth Evans, under whose direction most of the tests were run, for his guidance in assimilating and interpreting the test data. * * *

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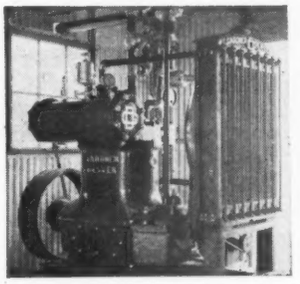
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Optimum Use of Coring, Electric Logging, and Other Testing Methods in Exploratory Wells†

JOHN E. WALSTROM*

In Two Parts—Part 1

In Part 1, individual logging and testing methods employed for evaluating the formations penetrated by a bore hole are reviewed. Emphasis is placed on the advantages and limitations of each method. Part 2 points out that it is necessary not only to know what each logging and testing technique accomplishes, and how reliable the results are, but also to know what combination of methods should be employed to obtain economically the desired amount of information.

ONE of the most critical and difficult technical problems challenging those who are concerned with exploratory drilling operations is the correct evaluation of the fluid content of the drilled formations. Very important responsibility is associated with this phase of exploration, because a wrong decision may forfeit not only the production from a single well, but from an entire oil field.

The development of equipment for sampling and testing formations began about 30 years ago. Since that time, several special tools and logging methods have been evolved to assist in the search for oil and gas. During the earlier stages of development of these tools, the desirability of using one in preference to another was often debated. One concept was that the electric log soon would replace the core barrel. It is now quite well established, however, that the various testing and logging methods furnish different types of information; that they have their respective advantages, and that they function best when used in a complementary manner in a planned program of exploration.

The present study is an analysis of the various methods by which the formations encountered in exploratory drilling may be evaluated through a coordinated use of the several sampling, testing, and logging techniques. First, the individual techniques are reviewed briefly and then their coordinated use in exploratory drilling is analyzed. In reviewing the techniques emphasis is placed on their advantages and disadvantages. A discussion of the principles fundamental to the mode of operation of the various methods has been omitted purposely, since such information may be found in the numerous references provided. The principal results of this analysis are presented in the form of three exploratory drilling program charts, classified on the basis of the formation evaluation methods that are used.

Coring

According to our information the first rotary core bit was made in 1863 by Leschat, a French engineer. No important improvements in this tool took place until about 1916, when core bits were introduced commercially in the oil fields. The general use of coring equipment began about 1923.[1]

The great advantage of coring is that a core is the direct physical evidence of the type of strata being penetrated by the bit and furnishes qualitative information concerning the formation fluids. If the core has the qualities of a possible reservoir rock, it often is subjected to a detailed laboratory examination which furnishes data on the porosity, permeability, formation factor, and interstitial water saturation.[2,3] These data describe the solid structure of the core at the temperature and pressure at which the measurements are made. Core analysis also provides measurements of the residual oil, water, and gas that remain in the core after withdrawal from the hole. The latter values, however, are not representative of the conditions in the reservoir prior to penetration by the coring bit. Cores may also be taken for paleontological or other geological determinations. The importance of core analysis to an understanding of reservoir performance was recognized very early.[4,5]

A significant disadvantage of coring, in an exploratory operation, is the inability to determine when to core, as it is generally not economical to core at closely spaced intervals. A core may be taken on the basis of a ditch or mud logging show, but where sands are thin even this may be too late to obtain a sample of the oil-bearing rock. Other shortcomings of coring are its relatively high cost in comparison with some of the other formation evaluation techniques, lost recovery, and the slower rate of penetration when coring most formations as compared with drilling.

It is often stated that one advantage of coring and core analysis is that these methods assist in the interpretation of the electric log. This is particularly true in a proved field where coring and core analysis, if employed in a few strategically selected wells, will materially aid in the interpretation of logs made in the many wells that are not cored. In an exploratory well, however, the value of this collaboration of techniques is not so great, as, if the core is taken, the presence of oil in the formation is usually determined by the core itself.

Formation Testing

Formation testing equipment was developed in the Mid-Continent and has been used commercially there since about 1926. Formation testing patents date back to approximately 1870, however, the formation tester was introduced into California about 1930.[6]

From one very important standpoint, formation testing, or drill stem testing as it is sometimes called, is superior to other formation evaluation methods in that it brings into play the dynamic forces within the reservoir. It is probably the most diagnostic test of the ability of the reservoir to produce, and the nature of this production. Formation tests may be made in open hole, using various types of packers; in stub liner or a full string of casing through slots or gun perforations. Obviously, a test made inside a full string of casing is practically equivalent to placing the well on production. Thus, the diagnostic efficiency of a formation test varies greatly, depending upon the way the test is made, the equipment used, and on the length of time the test is continued. The interpretation of the results of a formation test is often difficult and requires careful consideration

†Presented at the Annual Meeting of the API, Los Angeles, California, November 14, 1950.
*Well-logging consultant, Standard Oil Company of California, San Francisco, California.

[1]Bibliography follows Part 2.

of the many factors involved. The disadvantages of formation testing are: (1) the possibility of losing the hole while testing, and (2) the possibility of a misleading test due to a water sand masking the presence of an oil sand when both are exposed in the test interval; or due to low formation pressure, in which case, sufficient fluid may not enter the tester to be representative of the formation tested.

Sidewall Sampling

Sidewall sampling devices were first used in the late twenties[7] but did not attain a general use until the mid-thirties, when the development of electric logging made possible an optimum cooperative functioning of the two methods.

Sidewall sampling tools are run either on drill pipe with a wire line removable core barrel,[8,9] or on an insulated multi-conductor cable,[10,11] such as used for electric logging. Samples may be punched or actually cored from the wall of the hole by either the type of sampler run on drill pipe, or the type run on logging cable. The samples taken with drill pipe require more rig time, but are larger than those obtained on logging cable equipment. As the electric log is not obtained concurrently with drilling, possible oil or gas productive formations are often revealed that were not tested or cored. In such instances, the sidewall sampling technique may be of great assistance. The particular type of sidewall sampler chosen depends on the type of formations, number of samples required, and the purpose for which the samples are obtained. The outstanding advantage of sidewall sampling is that the samples usually may be obtained at minimum cost and at any preselected position in the hole after the electric log has been run which is in direct contrast to conventional or wire line coring. In general, sidewall samplers are employed most advantageously immediately after running the electric log.

Four disadvantages of sidewall sampling are: (1) The flushing action of the drilling fluid often reduces the diagnostic value of the measured fluid saturations to a minimum. (2) It is difficult to obtain dependable core analysis results on sidewall samples. (3) The samples are of questionable value when taken in a hole drilled with a fluid containing oil. (4) It is difficult to obtain adequate samples if a thick mud cake has formed.

Electric Logging

Electric logging was developed commercially in 1928[12] and was introduced into the United States in 1932.[13]

The advantages of electric logging are: (1) It supplies a continuous record along the entire open hole. (2) It is relatively inexpensive, as compared with coring and testing an equivalent interval. (3) It requires only a few hours rig time per survey. (4) It ordinarily does not endanger the hole. (5) Whereas core analysis data, such as permeability values, vary statistically over a wide range partly due to the small samples on which measurements are made, the electric log values are the result of measurements made on very large samples of formation more representative of the microscopic quality of the reservoir. This is an advantage of the electric log other than in thin laminated formations where it is a disadvantage. Correlation of the available electric logs in any area furnishes much structural information. The electric log also is used for locating water, obtaining a sand count,[14,15] estimating the relative fluid content,[16,17,18] determining optimum points at which to set the casing or a formation tester packer, and evaluating the magnitude of reserves.

The electric log has three significant disadvantages: (1) A high value of apparent resistivity on the long electrode spacing resistivity curves may be due not only to the presence of hydrocarbons; but may be caused by

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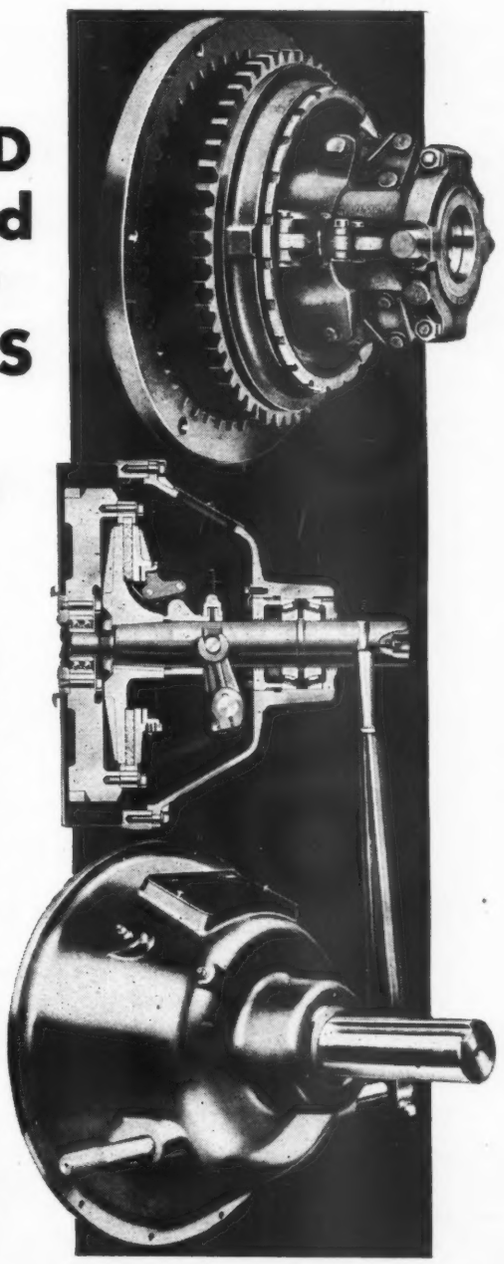

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fresh or brackish interstitial water, a relatively nonporous formation, or an interval seriously invaded by drilling fluid and drilling fluid filtrate. In operations of an exploratory nature, it sometimes is difficult to tell which of the above factors is responsible for the favorable appearance of the log. In difficult cases, the use of several spacings and special interpretive methods often will help. (2) The electric log is not obtained concurrently with the progress of the drill bit. This is in contrast to coring and cuttings analysis the results of which are obtained almost concurrently with the progress of the drill bit, thus allowing testing at the most opportune time and in the most opportune manner. (3) It should be pointed out that the diagnostic ability of the electric log is greatest in reservoirs having a granular type of porosity as exhibited by sandstones. An accurate analysis of electric logs made in fractured reservoirs, in which the fluid exists in cracks and fissures is often difficult or impossible.

It is interesting to note that although coring and testing give results directly in terms of fluid content and rock type, the electric log and radioactivity logs yield information concerning the electrical and radioactive characteristics of the formations. These characteristics must then be translated into values in terms of the physical entities, porosity, permeability, and fluid saturations. Since the electrical and radioactive characteristics of the formations usually involve the physical ones in a rather complex manner, the problem is difficult and often the solution is only an approximate one.

The several curves of the electric log may be regarded as a set of equations in which there are more unknown variables than there are equations. If the resistivity of the formation interstitial water and the formation factor are known or may be estimated, the diagnostic value of the electric log is enhanced considerably.[16] The effect of the presence of the mud column and invaded zone,[19] and the thickness of the sedimentary layers,[19] must also be taken into account when interpreting an electric log.

Mud Logging

Drilling fluid and cuttings analysis[20, 21, 22] methods of formation evaluation often are referred to, either individually or together, as "formation logging," "mud analysis logging" or merely mud logging and have been offered commercially since 1939.[23] The three outstanding advantages of this method are: (1) No extra rig time is necessary in order to collect the data. (2) The data are obtained almost concurrently with the progress of the drill bit, which usually allows coring and testing any show that is obtained. (3) Much unnecessary and blind coring is often eliminated.

Disadvantages of this technique are: (1) The oil and gas shows are of a qualitative nature. (2) Due to the necessity of constant supervision by skilled personnel, the service may be relatively expensive if drilling progress is slow. (3) The diagnostic effectiveness of mud logging is greatly reduced or nullified when a drilling fluid containing oil is used, and is also reduced in areas where many noncommercial accumulations of hydrocarbons exist.

Gamma-Ray Logging[24]

Gamma-ray logging was placed on a commercial basis in 1940.[25] The method measures the naturally existing gamma-radioactivity of the formations. Shales ordinarily show a higher radioactivity than sands and thus often may be delineated from the latter by means of a gamma-ray log.[26]

The advantage of the gamma-ray logging method is that it may be employed profitably in cased wells that

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were drilled and completed before the advent of electric logging. As the gamma-radiation penetrates the casing readily, a log may be obtained inside the casing showing the positions of the sands and shales. Such a log is of great advantage if it becomes desirable to enter an old well in order to perforate cased-off formations that have later been proved to be oil or gas-bearing.

The gamma-ray log frequently is run inside casing or liner in conjunction with a collar locator as one of the methods used to insure accurate gun-perforating when testing or completing under conditions in which the ordinary accuracy of measurements would not be suitable. Gamma-ray logging may also be employed in holes that are empty or those that are filled with an insulating fluid, such as oil or oil base fluid, either of which preclude the use of the conventional electric logging equipment. The gamma-ray method may be used in holes drilled with salt water since such conditions also do not lend themselves well to the electric logging method.

In the above applications, the gamma-ray curve is used as a correlation tool since it determines the geometry of sand-shale sequence. Its ability to function in this manner depends upon the contrast in intensity of natural radioactivity of the sands and the shales. The contrast in radioactivity of the sediments varies considerably from one general area to another. As a result, success of the gamma-ray log, as a correlation tool, must be established by trial in any particular field.

Neutron Logging

The neutron log has been available commercially since 1941.[27] This radioactivity well logging method usually is used in a complementary manner with the gamma-ray log; similar in some respects to the cooperative functioning of the potential and resistivity curves of the electric log.

Whereas the gamma-ray curve is used principally as a correlative tool to delineate sands from shales, the neutron log is influenced more by the fluid content of these formations. The neutron log has been used successfully to detect the presence of dry gas, and is also used to locate the fluid bearing zones in a generally dense limestone section. These two uses of the neutron log depend on the absence and presence of fluid, respectively. The ability of the neutron curve to detect fluid as a result of the interaction of the neutrons with the hydrogen nuclei present in the formations. Since both oil and water are hydrogenous, the neutron method is incapable of distinguishing between the two.

A new neutron technique has recently been developed[28] and is being offered commercially. This technique utilizes a detector which is sensitive to the scattered slow neutron flux rather than to the secondary gamma-radiation caused by the neutron bombardment. The advantages and disadvantages of this new technique remain to be evaluated.

As the neutron curve is an indicator of fluid, it will likewise be an indicator of porosity in formations in which the pore space is entirely filled with oil, water, or a combination of the two. Such a relationship between porosity and the neutron curve has been developed for limestone formations and is discussed in the literature.[29, 30]

Induction Logging[31]

The induction log was introduced on a commercial basis in 1947. The principal use of the induction logging method is to obtain a resistivity log in holes drilled with oil or oil based fluid without forcibly contacting the walls of the hole. The highly insulating nature of these fluids precludes the use of conventional electric logging equipment. An alternative method that is also used for logging in oil or oil base fluid is an electric logging system utilizing wire brushes that scratch the walls of the hole, making contact with the formations. The latter method has the disadvantage that the brushes sometimes make erratic and poor contact with the walls of the hole, which introduces spurious resistance in the circuits and impairs the quality of the curve. The use of forced contact with the walls is also more likely to result in sticking of the tool in the hole. Frequently, the induction log and the "scratcher" log are both employed when logging a hole drilled with oil base fluid or oil.

Both radioactivity logging and electric logging provide two types of curves. The gamma-ray curve of the radioactivity log and the potential curve of the electric log show the position of the various sands and shales penetrated by a well bore. They are essentially correlation curves. The neutron curve and the resistivity curves, on the other hand, are used primarily to study the fluid content of the formations. If oil base fluid has been used in the drilling of the hole and if the invaded zone is sufficiently small, the investigative radius of the induction logging system is sufficient to reach behind the invaded zone. Under these conditions, the induction log may be used to study the fluid content of the formations. The correlation curve in this instance may be either a gamma-ray or a single electrode scratcher curve.

It is important to point out some of the advantages inherent in the use of the induction log in oil base fluid. The standard type of electric log made in water base fluid is affected by the presence of the mud column, the presence of an invaded zone, and the presence of neighboring formations that may be included in the region of investigation. With induction logging: (1) The effect of the fluid column is minimized as the oil base fluid is highly resistive; (2) the effect of the invaded zone is minimized due to the low filter loss of the oil base drilling fluid; (3) due to the small invaded zone with oil base drilling fluid, the proximity effect of nearby formations is reduced as a sufficient radius of investigation may be obtained with a relatively small spacing.

The above discussion indicates that a low filter loss, electrically insulating drilling fluid, has some inherent advantages. These advantages probably will be more fully realized when more experience with induction logging is obtained and when the logging techniques are developed more perfectly. Nevertheless, at the present state of development of well logging, it is not desirable to drill a strictly exploratory well with oil base fluid as far as the electric log interpretation is concerned.

Although the potential and resistivity curves have been run simultaneously for many years, this has not generally been true of most other combination logging techniques. However, the induction logging equipment has recently been operated simultaneously with a single scratcher resistivity electrode. A combination gamma-ray neutron equipment also is being developed.[28]

The MicroLog[32]

As its name implies, the MicroLog reveals the minute changes in sedimentation. In contrast to conventional electric logging systems, which function best, if the thickness of the sedimentary layers is greater than several feet, the MicroLog indicates the presence of sediments only a few inches in thickness. This logging method is quite conventional except for the very close spacing of the electrodes and the manner of their application in the drill hole. The down-hole equipment consists of a rubber pad that is pressed against the wall of the hole by means of long springs attached to the mandril of the instrument. The electrodes are located on the outside surface of the rubber pad, facing the formations, but insulated by the pad from the short-circuiting action of the drilling fluid.

A standard MicroLog practice con-

sists of recording two curves; one-inch and two-inch, 2-electrode resistivity curves. The conductive filter cake of water base fluid present on a porous and permeable formation is detected easily since the one-inch curve is more affected by the filter cake than the two-inch curve. In this manner, the MicroLog detects the presence of filter cake, which is indirectly equivalent to detecting the permeable interval. The MicroLog is not diagnostic of the nature of the fluid content of the formations, since the technique is predominantly influenced by the filter cake and the invaded zone.

The MicroLog method of logging has been used very successfully in certain limestone reef areas to distinguish the porous from the dense intervals. Such determinations are of great assistance in calculating reserves and for determining the continuity of the porous zones throughout the field. In an exploratory operation in formations of this sort, the MicroLog would indicate which intervals in the lime were worthy of further evaluation.

Continuous Electric Logging at the Bit

During the period 1935 to 1941 considerable effort was expended to develop continuous electric logging at the drill bit.[33,34] The method consisted of insulating the bit from the drill pipe and providing each section of pipe with an insulated wire held within a tube brazed to the inner periphery of the drill pipe during the normalizing operation at the mill. Insulated male and female terminals at the ends of each section of pipe permitted the customary derrick floor make-up and break-out practice. A brush box was provided between the kelly and the swivel so that connections could be made to the surface equipment housed in a portable trailer. The bit was connected to the logging cable by means of a specially insulated drill collar and switch assembly. In this system, the bit is the electric logging electrode. Although this method of logging obtained some success, it remained in the development stage and was never used commercially or on a wide scale.

During the last few years another company has again initiated the development of a method of continuous logging. Although the bit manifestly must still function as the logging electrode, the means of providing a connection with the surface equipment and other elements of the system are radically different from those developed heretofore.

The chief advantage of logging at the bit is the simultaneity of the drilling and logging, which allows the coring and testing of an interesting horizon before deeper formations are exposed. A further consideration that will need to be evaluated by more experience is the possible advantage to be gained by logging before the invaded zone is fully established.

Although many of the characteristics of this logging method still have to be determined, it is interesting to point out one or two ways in which the method differs from the conventional electric logging system. As a single electrode is utilized, bed thickness effects should not be as disturbing as they are for the long spacing resistivity systems commonly employed. Since the electrode is large, and as no open hole exists below the electrode while drilling, there should be less hole effect than with the conventional single electrode system. With this type of logging method a potential due to the contact of the steel bit with the formations will probably be an important part of the total potential measurement. It is difficult to foresee at the present time whether this will enhance the value of the potential curve or not. Furthermore, logging at the bit will make possible the recording of curves both while drilling and while pulling the pipe out of the hole. Since the filtration into the forma-

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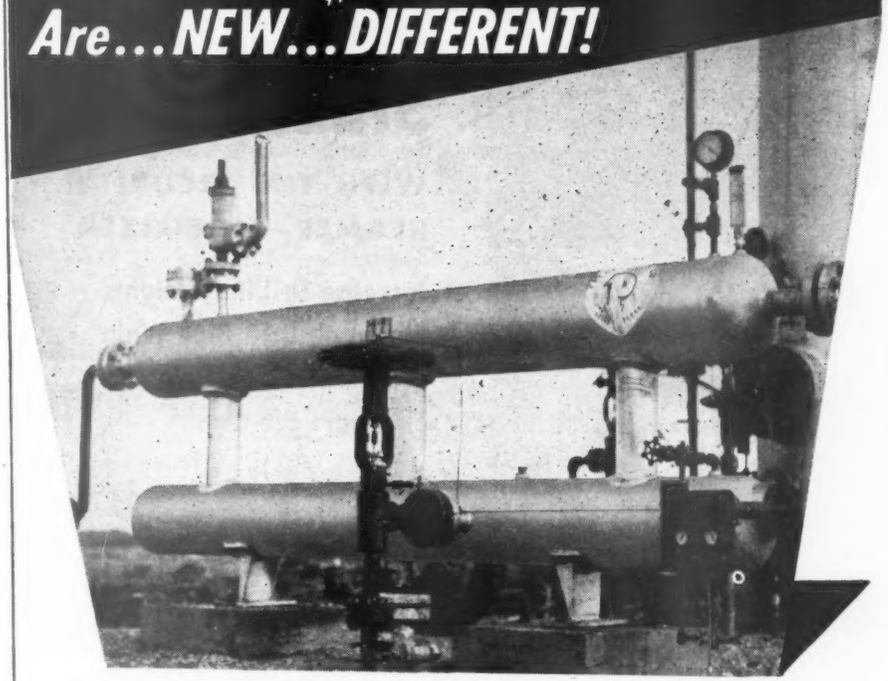

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tions of drilling fluid filtrate is very likely different under the two conditions, a comparison of the two curves may possibly yield qualitative information concerning the permeability of the various strata. The above considerations outline a few of the more important ways in which logging at the drill bit differs from conventional electric logging.

Fig. 1 shows a comparison between a conventional electric log and one recorded concurrently with the progress of the drill bit. Although the Drill Logger does not strictly measure resistivity, the Drill Logger resistance curve is shown beside the electric log resistivity curve in a somewhat displaced position for comparison purposes. An excellent resemblance between these two curves exists. The Drill Logger potential curve correlates well with the electric log potential curve and shows considerably stronger potentials than the latter.

Drilling Fluid Considerations

The type of drilling fluid used in an exploratory operation is determined by both the drilling requirements and formation evaluation considerations. The fluid chosen should be one that renders the various formation evaluation methods most diagnostic and at the same time is compatible with the expected drilling conditions. Although the successful drilling of a hole in the ground is not the main purpose of an exploratory well, it is most certainly a prerequisite of the operation.

The use of a drilling fluid containing oil decreases the efficiency of mud logging methods and devaluates the significance attached to oil showings in sidewall samples. The presence of oil in the mud column will not affect adversely the conventional electric logging technique, unless the fluid is composed largely of oil or oil base and is thus electrically insulating. In this case, as previously discussed, induction logging, gamma-ray logging, or wall scratching methods are employed. As the data supplied by these latter methods have not yet reached

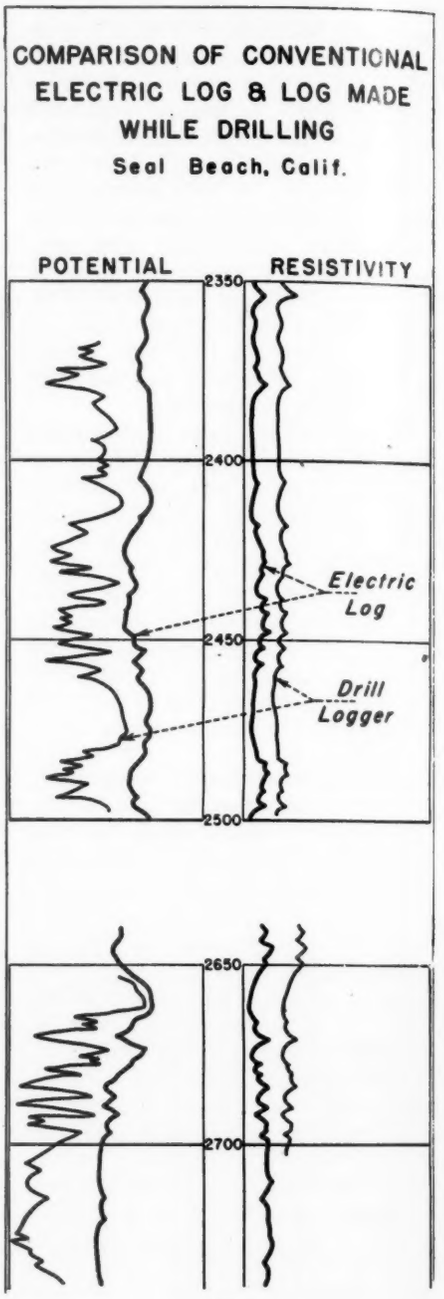

FIG. 1

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the same level of usefulness as that furnished by the electric log, it is only logical to conclude that a conductive water base fluid is ordinarily preferable for exploratory operations.

Salt water is not usually considered a good circulating fluid as far as exploratory formation evaluation is concerned, as it frequently affects in an adverse manner both the potential and resistivity curves of the electric log. The excessive invasion that may occur when using water as a circulating fluid may preclude the determination of the true resistivity of the formation and mask the results of a formation test.

Some drilling fluids have a detrimental effect on the potential curve of the electric log due to the electrochemical nature of the fluid. Such an effect has sometimes been noticed when lime-treated fluids have been employed. The effect on the potential curve is unpredictable and may possibly depend in some way on the history of the fluid treatment. In view of this effect, it is clear that the diagnostic efficiency of the electric log may be greatly reduced when such fluids are used.

Varied opinions exist concerning the characteristics that a drilling fluid should have in order to make the best possible interpretation of the electric log. However, taking into account as many factors as possible, it is believed that these characteristics are:

(1) The fluid should be electrically conductive, and have a resistivity between 1 and 3 ohm-meters at surface temperatures.

(2) Under hole conditions of temperature and pressure, the filter loss should be very small, but not zero.

(3) The electro-chemical nature of the fluid should be such that a normal type of potential curve is recorded.

A small but finite filter loss is desirable since the most effective interpretation of the resistivity curves is made when some invasion has taken place. Although some oil emulsion fluids satisfy these conditions, they do not lend themselves as well to interpretation of mud logging and coring results as a mud that does not contain oil. Thus, as far as formation evaluation in general is concerned, it is necessary to add a fourth characteristic:

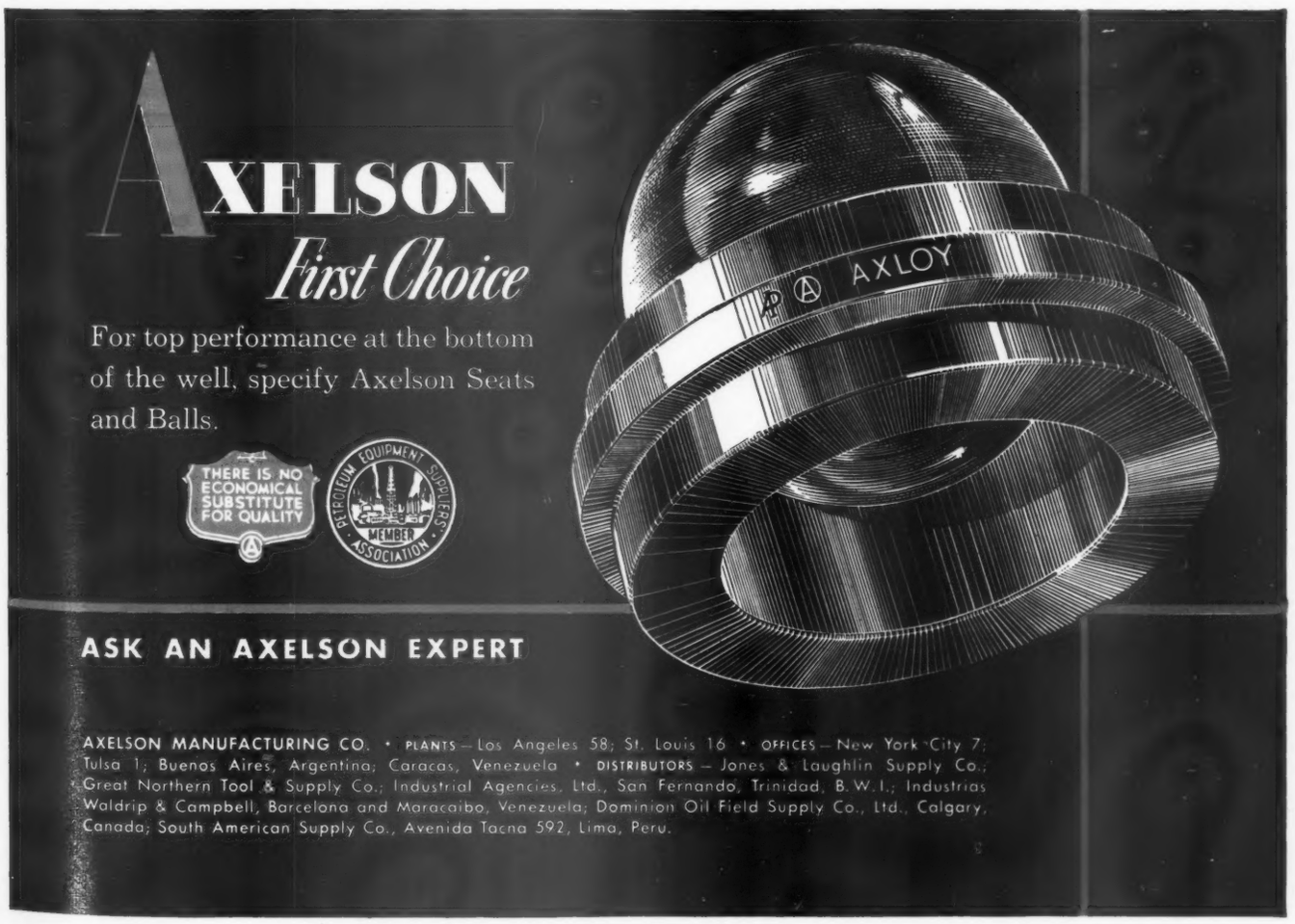
(4) The fluid should not contain oil.

It is realized that special methods and techniques may be developed in the future that would modify considerably the above specifications. These requisites are postulated on a basis of the present state of development of logging techniques and interpretive methods, however. * * *

Part 2 will be published soon.

Tests Oil Country Tubing

To simulate oil well conditions in testing its oil country tubing, National Tube Company, a U. S. Steel subsidiary, has developed a special machine, which floods drill pipe with brine while rotating it for weeks under bending forces up to 1,200,000 in-lb. The machine measures the resistance of pipe to stresses that may cause fatigue failure during drilling. Other new tests devised by this company include burst, collapse, stretch, and impact. Its research laboratory announced the installation of a battery of 20 creep-testing machines of the most modern design and a full line of new dynamic strain-gaging equipment for testing pipe and joints.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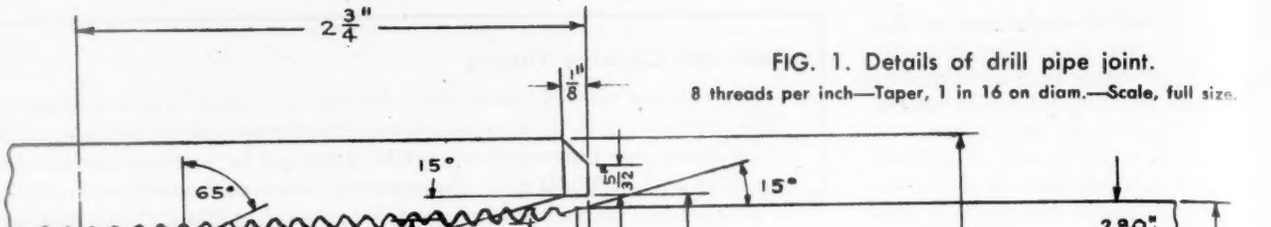


FIG. 1. Details of drill pipe joint.
8 threads per inch—Taper, 1 in 16 on diam.—Scale, full size.

A Three-Dimensional Photoelastic Stress Analysis of a Threaded Drill Pipe Joint†

WILLIAM F. FRANZ*

THE rotary method of drilling oil wells involves the use of a hollow drill shaft, the sections of which are connected by taper threaded pipe joints. Drilling mud is pumped down the center of the shaft and up around the outside, one purpose being to remove the drill cuttings from the well. The threaded connections are subjected to corrosive conditions under varying tensile, compressive, and torsional forces. Fatigue failures of these joints are not uncommon and add considerably to the cost of the well. As a step forward in the effort to improve the fatigue strength of this type of connection, it was desired to make a three dimensional photoelastic investigation of a threaded drill pipe joint and thereby obtain the factor of stress concentration of the joint.

Fixation Method

The fixation method of three dimensional photoelastic stress analysis consists basically of loading a specimen at an elevated temperature and

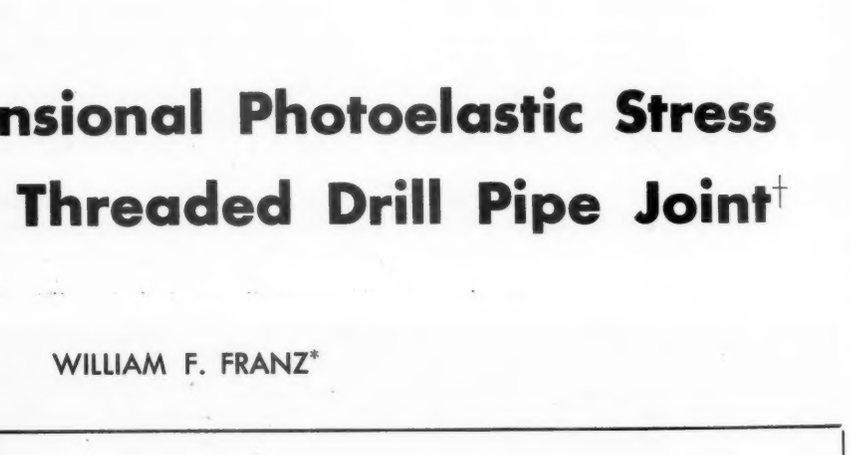


FIG. 2. Enlarged detail of thread profile.

*Research Laboratory, National Tube Company, U. S. Steel Corporation Subsidiary.

†Presented at the annual meeting of the Society for Experimental Stress Analysis, November 29, 1950, New York, New York.

cooling slowly while under load. The material used for this project was Fosterite, a development of the Westinghouse Research Laboratories. The stress "freezing" process of the fixation method can be best explained by considering the material to consist of a honeycomb structure filled with a substance that has a lower melting point than that of the structure. At the loading temperature the honeycomb structure is still elastic, but the internal or filler substance is in a plastic state. A load applied at the elevated temperature will cause an elastic deformation that will disappear if the load is removed. If the load is held while the temperature is slowly decreased, however, the plastic substance will freeze and lock the elastic strains in the specimen. Thin sections can be sliced out in any direction without disturbing the original three dimensional stress conditions and the slices analyzed in a standard two dimensional polariscope.

The stress freezing, or more properly, the strain freezing process, may be considered to result in a type of residual stress between molecules. This type of residual stress should not be confused with the commonly referred to residual stress for which finite sections of a body are in equilibrium with locked-up stresses in another section of the same body. Commonly referred to residual stresses may be introduced by heat treatment, work hardening, etc., and are altered considerably when the body containing these stresses is cut in any manner. The frozen strains in the photoelastic model retain their original three dimensional values, regardless of direction or thickness of cut.

Test Specimens

The drill pipe joint chosen for this investigation was a 2⅜ in. outside diameter American Petroleum Institute standard internal upset drill pipe joint. (Upset pipe has a forged wall at the threads of the pipe which is heavier than the normal pipe wall thickness.) A longitudinal section through the coupling and pipe walls is shown in Fig. 1, and the enlarged detail of the thread profile is shown in Fig. 2. The thread is of the round top and bottom type with a root radius of .017 in. and crest radius of .020 in. which results in a .003 clearance between the crest and root of mated threads.

The first specimen was machined to full scale, but the low modulus of elasticity of Fosterite at the elevated temperature caused excessive expansion of the coupling end, which resulted in a different load distribution along the threads than exists in a steel joint. Most of this expansion could have been eliminated by making the coupling wall thicker, but the effect on stress conditions had to be considered.

Hoop stresses induced in the pipe and coupling by screwing the joint power tight is dependent on the relative circumferential rigidity of the pipe and coupling, and interference of the tapered threads. Make-up hoop stresses in steel joints have been measured with electric strain gages, and compressive hoop stresses at the end of the pipe have been found to be close to the yield point of the steel. Because of the large difference in moduli of elasticity of steel and Fos-

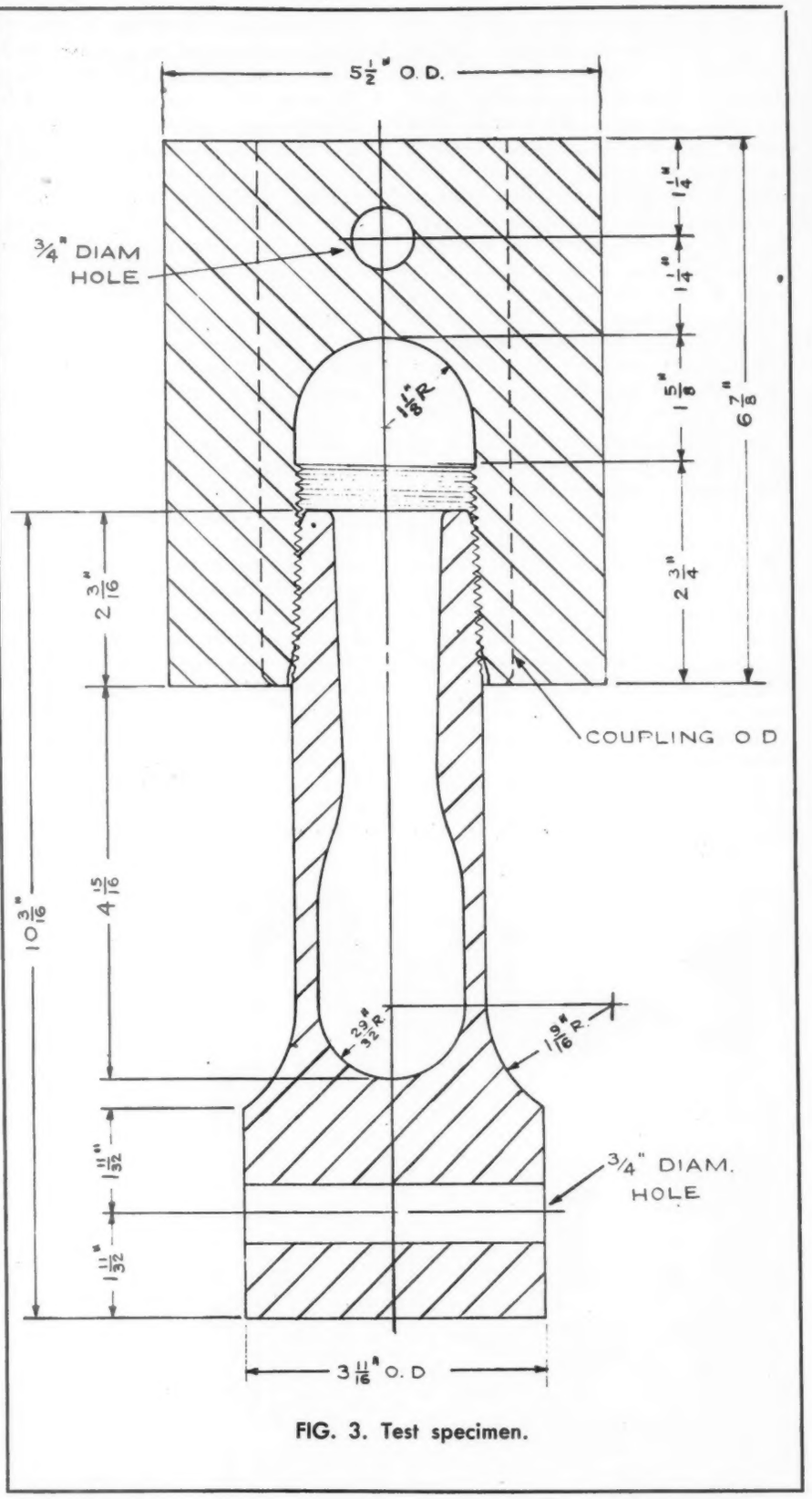


FIG. 3. Test specimen.

terite, the thread taper would have to be increased beyond the point of being practical in order to induce the same degree of make-up stress in the Fosterite joint. Changing the thread taper would also alter the longitudinal stress condition that was to be avoided. The make-up hoop stress at the point of fatigue failure (root of last engaged pipe thread) is usually low, and preliminary fatigue tests on steel joints seem to indicate that the degree of make-up has little or no effect on fatigue strength. For these reasons, it was believed that the effect of make-up would not alter the results desired to any great extent.

Relative circumferential rigidity of pipe and coupling is also important if the friction between thread flanks were overcome. This has been found to happen only near the point of failure of a non-upset steel joint under tensile load. Once sliding on the thread flanks starts, the pipe portion of the joint fails in hoop compression since the high make-up stress is already present. This high load condition is to be avoided if conditions under normal fatigue failure are to be obtained.

The longitudinal rigidity of pipe and coupling does effect the load distribution along the threads. If the same coupling thickness is used for the Fosterite coupling as is used in the steel prototype, the low modulus of elasticity of Fosterite will cause the longitudinal rigidity to be less than that of the steel coupling. By making the coupling wall oversize, the longitudinal rigidity would be caused to approach that of the steel coupling and will also decrease the undesirable circumferential expansion experienced with the first test specimen. A second specimen was then made exactly the same as the first specimen except that the coupling had a larger outside diameter. Details of the test specimens are shown in Fig. 3.

Both specimens were machined from solid bar stock, soda water being used as a coolant for all machining operations. The threads on the pipe and coupling were machined by the use of standard thread chasing (combing) tools. The pitch diameters of the threads were controlled so that 3 threads were exposed outside of the coupling when the joint was screwed up hand tight at room temperature. This is the normal hand tight stand-off of the steel joint.

Small tension specimens were machined from the same stock used to machine the pipe portion of the joint and stress frozen simultaneously with the joint specimen to obtain a calibration for the fringe value of the material.

Test Procedure

The specimens were stress frozen in the large photoelastic stress freezing oven at the Westinghouse Research Laboratories. A picture of this oven taken during the stress freezing of the first specimen is shown in Fig. 4.

After screwing the joint up hand tight (3 threads exposed), the joint and calibration specimens were suspended in the oven and the temperature increased to 100 C where it was held for 2 hours so that a uniform temperature existed throughout the specimen. The joint was then made-up 3 more turns to simulate the power make-up of the steel pipe joint. In the next 2 hours the temperature was decreased to 80 C while the tensile loads were continually increased until at 80 C the loads were 156.1 lb on the joint and 6.34 lb on the calibration specimen. The reason for the increase in load with decrease of temperature was to obtain the benefit of the increase in strength of the material as a precaution against the failure of the specimen at the loading pins. From 80 C the temperature was slowly decreased at the rate of 1½ C per hour until room temperature was reached. The specimen then contained the combined stresses of both power make-up and tensile load.

Longitudinal sections $\frac{1}{16}$ and $\frac{1}{8}$ in. thick were milled out of the joint by the use of 2 slitting cutters separated by a spacer. It was found necessary to use an abundance of soda water coolant in order to prevent the annealing out of fringes due to the heat of friction of the cutter blades. This was especially critical on the $\frac{1}{16}$ in. thick slices because there was small capacity for heat dispersion within the slices.

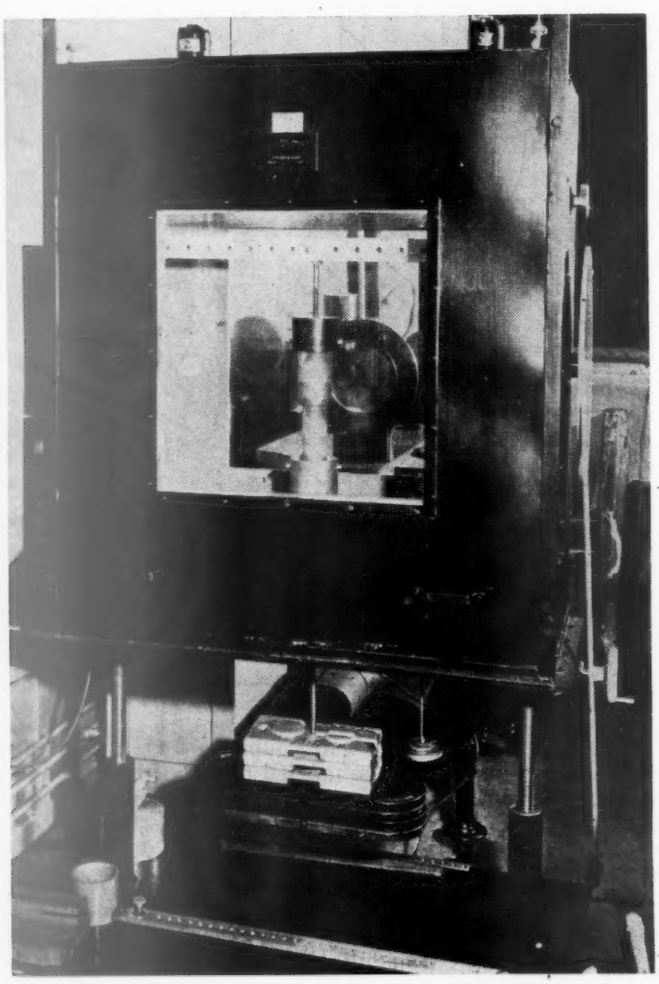
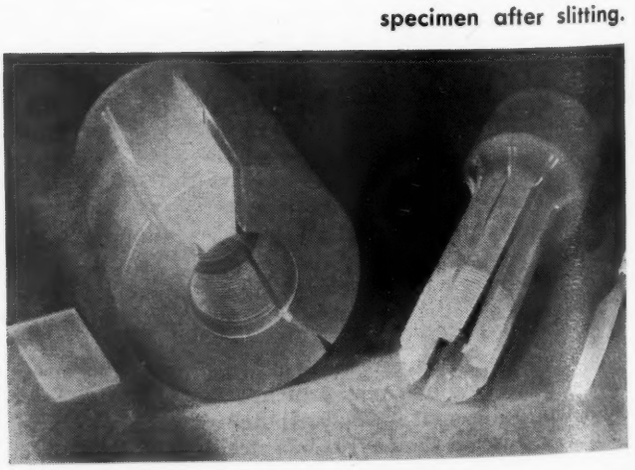


FIG. 4. Stress freezing oven.

FIG. 5. Second test specimen after slitting.



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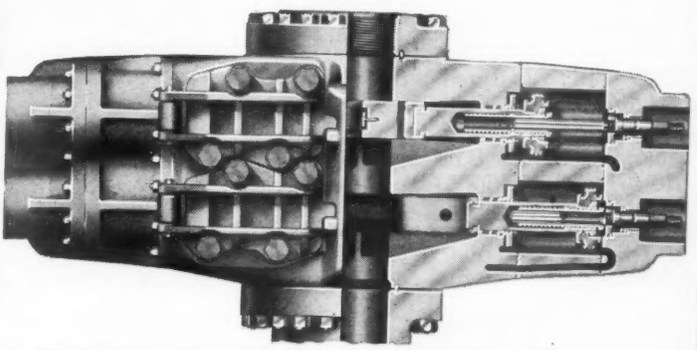

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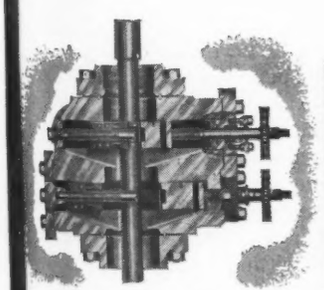

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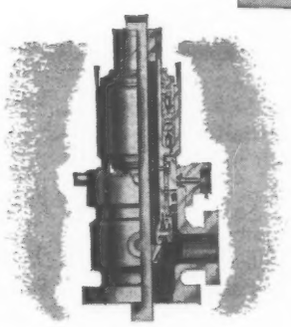

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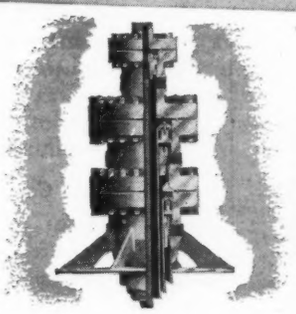

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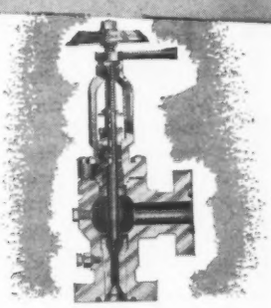

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A picture of the second specimen after removing the slices is shown in Fig. 5. As the pipe portion of the joint contained the critical point to be analyzed, 9 slices were taken from this part, although only 3 were taken from the coupling.

The milled sections were immersed in a hallowax bath to give the effect of a polished specimen (the index of refraction of hallowax being very close to that of Fosterite). The fringe patterns were analyzed in the standard two dimensional polariscope shown in Fig. 6. Both black and white backgrounds were used in analyzing the slices, but the white background was found to be better for obtaining a distinct boundary. The small radius at the root of the thread together with the transverse curvature made it difficult to analyze the small fringes. The maximum fringe order was finally obtained by the use of a short focal length lens and bellows extension acting as a microscope to enlarge the root of the thread directly onto the film. Considerable care was taken to make sure that the point of analysis was on the optical axis of all lenses involved. In this manner any shadows due to the thickness of the slice were eliminated. The maximum fringe order on a $\frac{1}{16}$ in. thick slice from the second specimen was 5 with the 4.5 fringe being between one and a half to two ten thousandths of an inch in width.

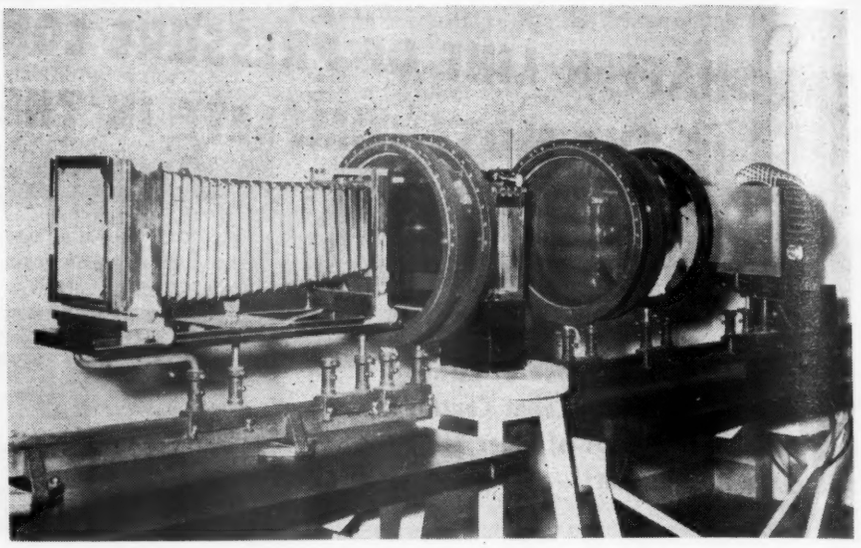

FIG. 6. Polariscope used in analyzing slices.

Calculations

The factor of stress concentration (k), as referred to photoelastically, is the ratio of the actual stress at a point to the average or nominal calculated stress. The point of maximum stress is naturally the point at which the factor of stress concentration is desired. This factor can be calculated as follows:

$$k = \frac{\sigma m}{\sigma a}$$

but,

$$\sigma m = n\frac{f}{t} = n\,F$$

$$\sigma a = \frac{P}{A}$$

and,

$$k = \frac{nFA}{P}$$

where,

- f = material fringe value determined by the calibration specimen and is equal to 2.62 psi for 1 in. thickness for the first specimen and 3.10 psi for 1 in. thickness for the second specimen.
- F = fringe value of slice in psi/fringe.
- t = thickness of slice in inches.
- n = maximum fringe order at point of analysis.
- σm = actual stress at point of analysis in psi.
- σa = calculated stress in psi.
- P = tensile load in pounds on cross section containing point of analysis.
- A = transverse cross section at point of analysis in square inches.
- k = factor of stress concentration.

The reason for the difference in the value of f for the two models is that the first model was made from an earlier experimental Fosterite material than the second specimen.

As the fringe order is proportional to the difference of the principal stresses, (p — q), this method of obtaining the actual maximum stress, p or σ_m, is valid only at a free boundary; that is, at a point on the surface of the specimen that does not have an

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The story of Col. E. A. L. Roberts and his invention in 1864 of the method used in "shooting" paraffin-clogged oil wells is told in the article "The Most Dangerous Job in the World," in the January 27 issue of The Saturday Evening Post.

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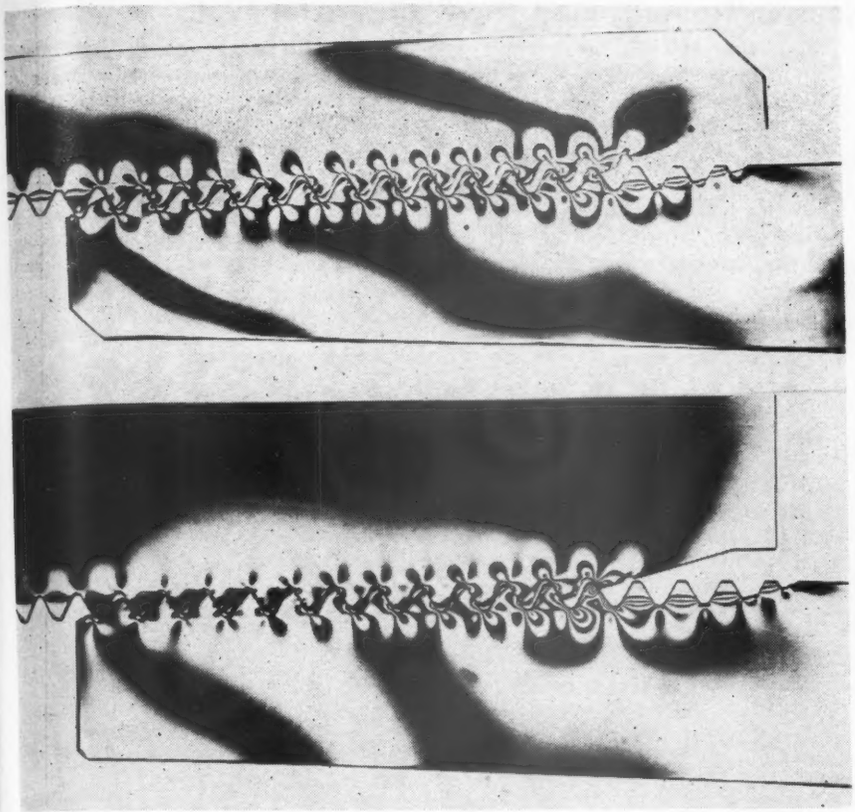


FIG. 7. Specimen No. 1.

external force applied to it and, therefore, one of the principal stresses (q in this case) is zero. This condition is satisfied for this case.

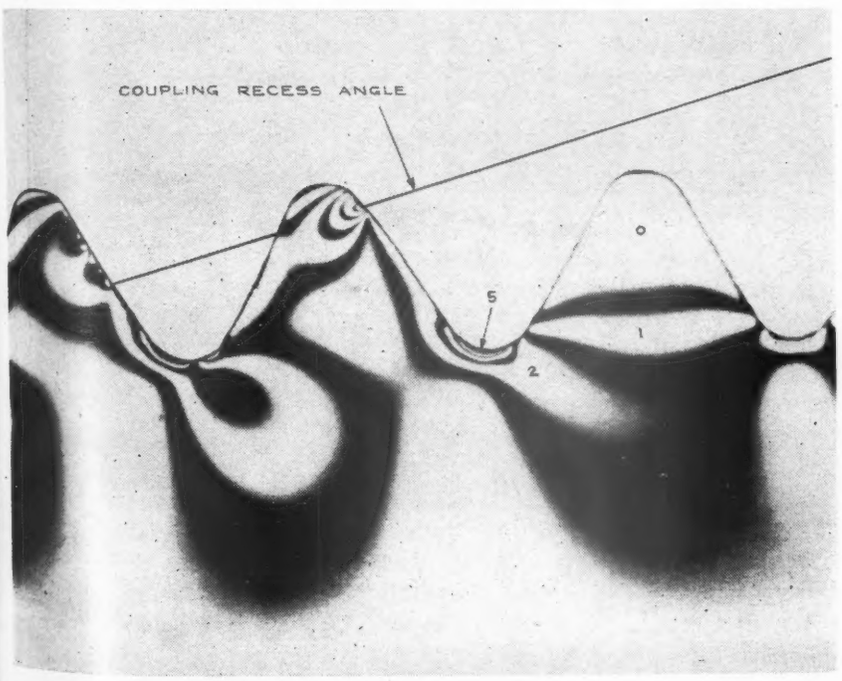
Results

The low modulus of elasticity (about 2320 psi) of Fosterite at the elevated temperature caused the coupling on the first test specimen to overexpand and resulted in a more even load distribution along the threads than exists in the steel joint. The large coupling wall on the second test joint prevented excessive expansion of the coupling and simulated the conditions of a steel joint rather closely. Pictures of 1/8 in. thick slices taken from both test specimens are shown in Fig. 7. Analysis of these fringe patterns shows the load to be rather concentrated in the last few engaged threads of the second test specimen and distributed to a certain extent over the entire thread length of the first specimen. The second test specimen represents more closely the conditions prevailing in the steel joint.

The point of maximum stress concentration was found to be at the root of the last engaged pipe thread, which is the location of the majority of fatigue failures encountered in practice. The degree of stress concentration was found to be fairly constant around the pipe, being independent of the point of contact of the coupling recess angle with the pipe thread. (The 15 deg angle on the inside of the coupling is shown in Fig. 1.) The fringe pattern of a $\frac{1}{16}$ in. thick slice from the second specimen is shown in Fig. 8. The maximum fringe order of 5 at the root of the last engaged thread results in a factor of stress concentration of 4.2. As the shadow at the root of the thread due to the transverse curvature is .0003 in. deep for the thickness of this slice, it is possible for the fringe order of 5½ to be hidden in the shadow. If the 5½ fringe does exist, the factor of stress concentration would then be increased to 4.6. The maximum factor of stress concentration for the first specimen was found to be 3.1, the effect of coupling expansion being the cause for the lower factor.

The results obtained with the second test specimen agree rather closely with results of actual fatigue tests made with polished test specimens and threaded pipe joint specimens using the same steel. There is some deviation, however, depending on the notch sensitivity of the steel and size effect; but for the majority of steels used in this application, the ratios of endurance limits obtained from the two types of fatigue tests is between 4 and 5. This ratio is obtained by taking the stress for ten million cycles of stress on the polished specimen and dividing by the calculated stress at the point of failure for ten million cycles of stress on the pipe joint. This ratio is equivalent to the photoelastic factor of stress concentration.

FIG. 8. Slice, 1/16-in. thick, from Specimen No. 2.



Acknowledgment

The author wishes to express his appreciation to the Westinghouse Research Laboratories of the Westinghouse Electric Corporation, especially Mr. M. M. Levin, for the splendid cooperation and assistance given in stress freezing the models, and also to the author's co-worker, A. F. Hundertmark for his assistance. * * *

NEWS

Iran Production Up For Month of November

Production of crude oil in Iran for the month of November, 1950 amounted to 2,578,000 long tons, according to a report by the Anglo-Iranian Oil Company, Ltd. This compared with 2,534,000 long tons produced in October. Total production for the period January 1 to November 30, 1950 was 28,805,000 long tons.

Colorado Offices Set Up By Deep Rock Oil

Deep Rock Oil Corporation announced the opening recently of new offices in Denver and Sterling, Colorado to extend the company's land and exploration work in the Rocky Mountain region.

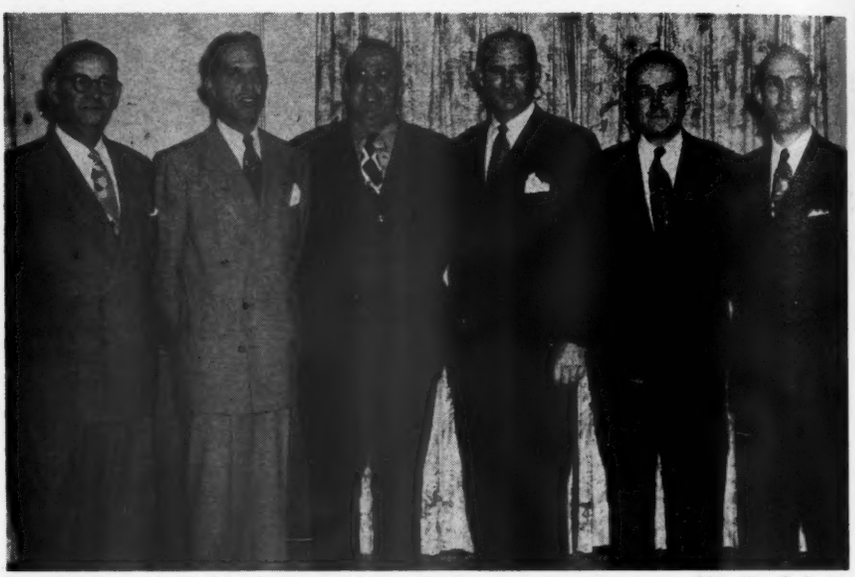
Heading the area office at Denver is W. C. MacQuown, Jr. A native of Pennsylvania, MacQuown attended Allegheny College for 3 years before transferring to the University of Rochester to receive his A.B. degree in 1938 and M.S. degree in 1940. He earned his Ph.D. in structural geology at Cornell University in 1943, then began working for Magnolia Petroleum Company in Dallas, Texas. In 1948 he joined the Cooperative Refinery Association where he remained until his Deep Rock appointment.

Kenneth Webb, formerly geologist in Deep Rock's Wichita offices, is now stationed at Sterling.

Houston Nomads Elect New Officers for 1951

The annual election of officers of the Houston, Texas chapter of Nomads was held at the College Inn, January 8, and were officially installed at the annual dinner dance held at the Shamrock Hotel January 27.

They are: Wayne Rives, The Oil and Gas Journal, president; Herschel Wood, Lebanon Steel Foundry, vice president; E. F. (Salty) Baldwin, Hughes Tool Company, secretary-treasurer; Larry Kelley, Hillman-Kelley Company, assistant secretary-treasurer; Bob Franklin, Rolo Manufacturing Company, sergeant-at-arms; Jay Speece, Gardner-Denver Company, deputy sergeant-at-arms; Ed Loreh, Cameron Iron Works, and Tracy Word, Well Equipment Manufacturing Company, regents, and Harry Estes, A-1 Bit and Tool Company, executive secretary.



Foreign guests of the Houston Nomad's January meeting are: W. O. Calvert, manufacturers representative, London, England; John W. Gunn, Texas Petroleum, Colombia; Doc Skinner, Homco Service, Inc.; W. F. "Blondy" Roberts, Reed Roller Bit, Caracas, Venezuela; J. M. de la Garza, Pemex, Mexico City, and J. Ralph Coleman, CIMA, Mexico City.

Visitors at the December meeting were, front row, Glenn Byers, Shell, Houston; E. J. Huber, Shell, Bogota, Colombia, S. A.; H. H. Harman, New York Chapter; R. L. Holden, Texas Company, Bogota; Mont Land, Petrolite, Venezuela; R. R. G. Rivington, Asiatic Shell, Houston. Back row, Don Meek, CIMA, Houston; E. E. McGarr, Tropical, Venezuela; G. A. Jaggers, Welex Jet Service, Fort Worth; W. Mengden, Superior Oil of Venezuela, J. P. Itz, Shell, Sumatra; and G. H. Garrott, National Bank of Commerce, Houston.

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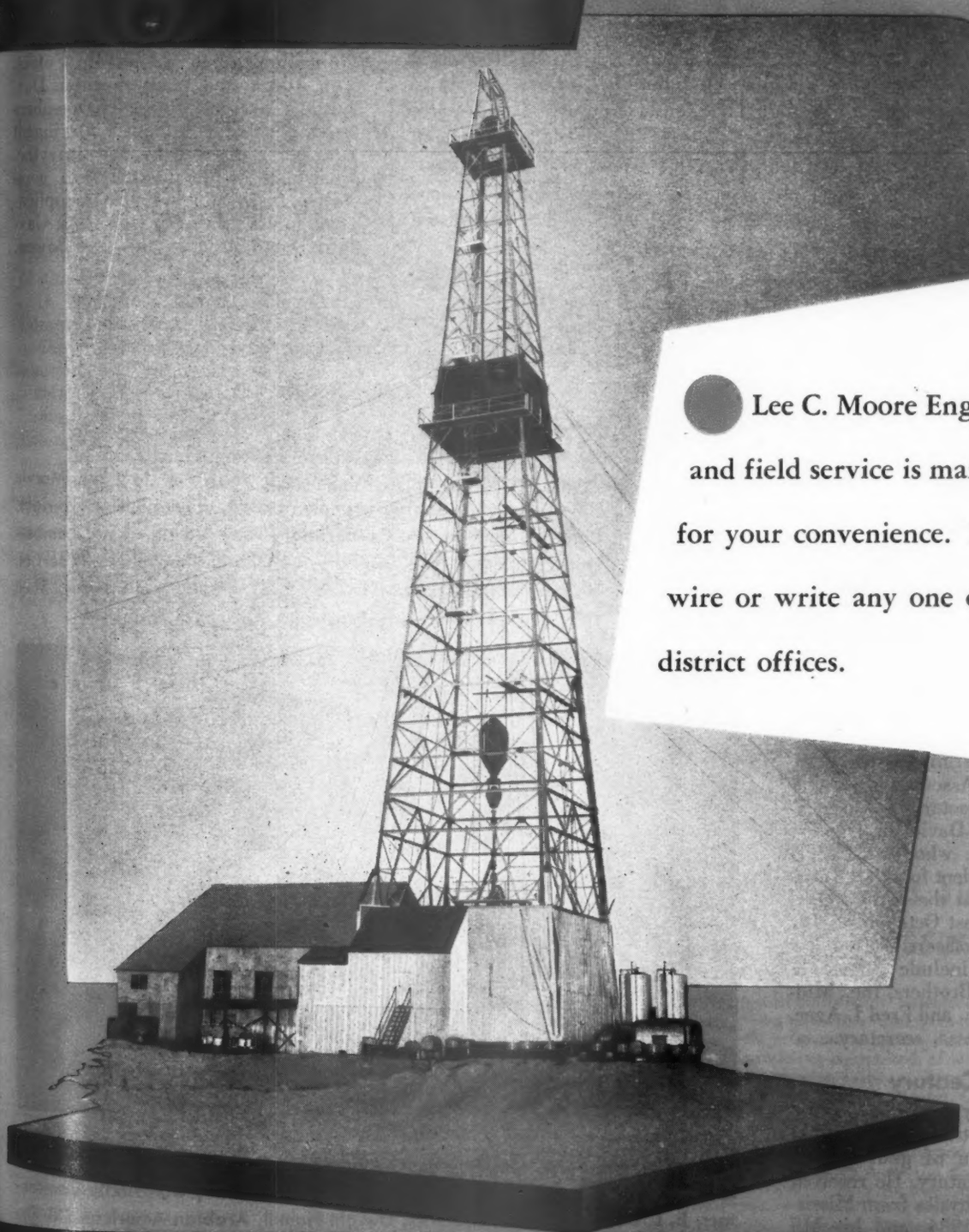

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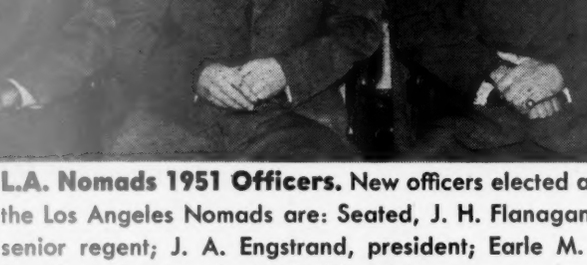
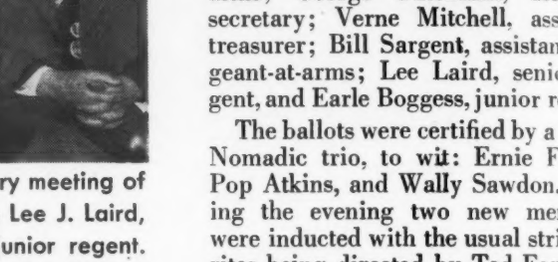
L.A. Nomads 1951 Officers. New officers elected at the January meeting of the Los Angeles Nomads are: Seated, J. H. Flanagan, treasurer; Lee J. Laird, senior regent; J. A. Engstrand, president; Earle M. Boggess, junior regent. Standing, Vernon A. Mitchell, assistant treasurer; George W. Gutekunst, assistant secretary; John W. Rife, and James D. Hughes, sergeant-at-arms. Officers elected but not pictured are Earl M. Rees, vice president; W. A. Wilson, secretary, and W. H. Sargent, assistant sergeant-at-arms.

Engstrand Is President Of L.A. Chapter Nomads

Jerry Engstrand, vice president of Grant Oil Tool Company was elected president of the Los Angeles Nomads at the January meeting, and will be duly installed at the Inaugural Ball at the Ambassador Hotel on the evening of February 17. Other officers elected were: Earl Rees, vice president; Bill Wilson, secretary; John Flanagan, treasurer; Jim Hughes, sergeant-at-arms; George Gutekunst, assistant secretary; Verne Mitchell, assistant treasurer; Bill Sargent, assistant sergeant-at-arms; Lee Laird, senior regent, and Earle Boggess, junior regent.

The ballots were certified by a noted Nomadic trio, to wit: Ernie Fowks, Pop Atkins, and Wally Sawdon. During the evening two new members were inducted with the usual stringent rites being directed by Ted Forsythe. Chairman of the membership committee, Jack Ballagh, reported applications for membership from Jack Gaylord, Dante Siracusa, and Fred Bowen.





New Members of L. A. Nomads shown at left are Marvin "Monk" Cook, export representative, and Bill Nelley, right, Refinery Maintenance Corporation. They are receiving membership certificates from Ted Forsythe, center. Above are Robert N. Hadow, British Consul-General; R. G. "Bob" Kettenburg, Shell Oil Company, and Jerry Engstrand, Grant Oil Tool.

Heads Local AAODC

Fred Bayless, Big Chief Drilling Company, Odessa, Texas, was elected chairman of the Permian Basin chapter of American Association of Oilwell Drilling Contractors. He succeeds H. W. Davidson, Davidson Drilling Company, Odessa, who was elected AAODC vice president for West Texas and New Mexico at the tenth annual meeting in Tulsa last October.

Other chapter officers elected for the coming year include Robert C. Schmidt, Loffland Brothers, Inc., Midland, vice chairman, and Fred J. Agee, J. F. Postelle, Odessa, secretary.

Clayton Joins Century

Century Geophysical Corporation has announced that Neal Clayton has taken the position of geophysical supervisor with Century. He received his AB degree in physics from Mississippi College in 1934, and his MS degree in 1937 from Louisiana State.

Foreign Guests at the L. A. Nomads' December meeting were: Standing: Z. W. McCoy, Colombian Petroleum Company; J. R. Drum, Shell (CPC); Paul H. Arnot, Arabian-American Oil. Seated: Bob Block, recently with Arctic Contractors; E. L. Davis, Arctic Contractors; Dwight Hamill, Arabian-American Oil; Dr. E. Frias, Rio de Janeiro, Brazil.

Name ASME Officers Of Petroleum Division

J. M. Sexton, of M. W. Kellogg Company, New York, has replaced E. W. Jacobson as chairman of the American Society of Mechanical Engineers, petroleum division. Sexton has served the division in past years as chairman of the manufacturers committee and as secretary of the division. B. B. Morton, International Nickel Company, New York, succeeds Sexton as secretary.

M. P. Watson, United Gas Pipe Line Company, New Orleans, Louisiana, takes over the chairmanship of the production engineering committee, F. V. Daasch, Gulf Oil, Tulsa, will serve as vice-chairman.

E. N. Kemler, of the University of Minnesota, in Minneapolis, has resigned the chairmanship of the production committee to accept a new appointment as research secretary for the ASME petroleum division.

F. H. Warren, Ohio Oil Company, Findlay, Ohio, continues as chairman of the transportation group.

O. L. Lewis, of C. F. Braun and Company, Alhambra, California, was appointed chairman of the refining committee to replace P. E. Frank, of Sinclair Refining, New York. Charles Draughon, of Esso Standard Oil, at Baton Rouge, will serve as vice chairman of this committee.

S. Mensonides, Farrar and Tretts, Incorporated, Buffalo, New York, replaces D. E. Fields of Tulsa, as chairman of the manufacturers committee. T. L. White, of Youngstown, Ohio, will serve as vice-chairman.

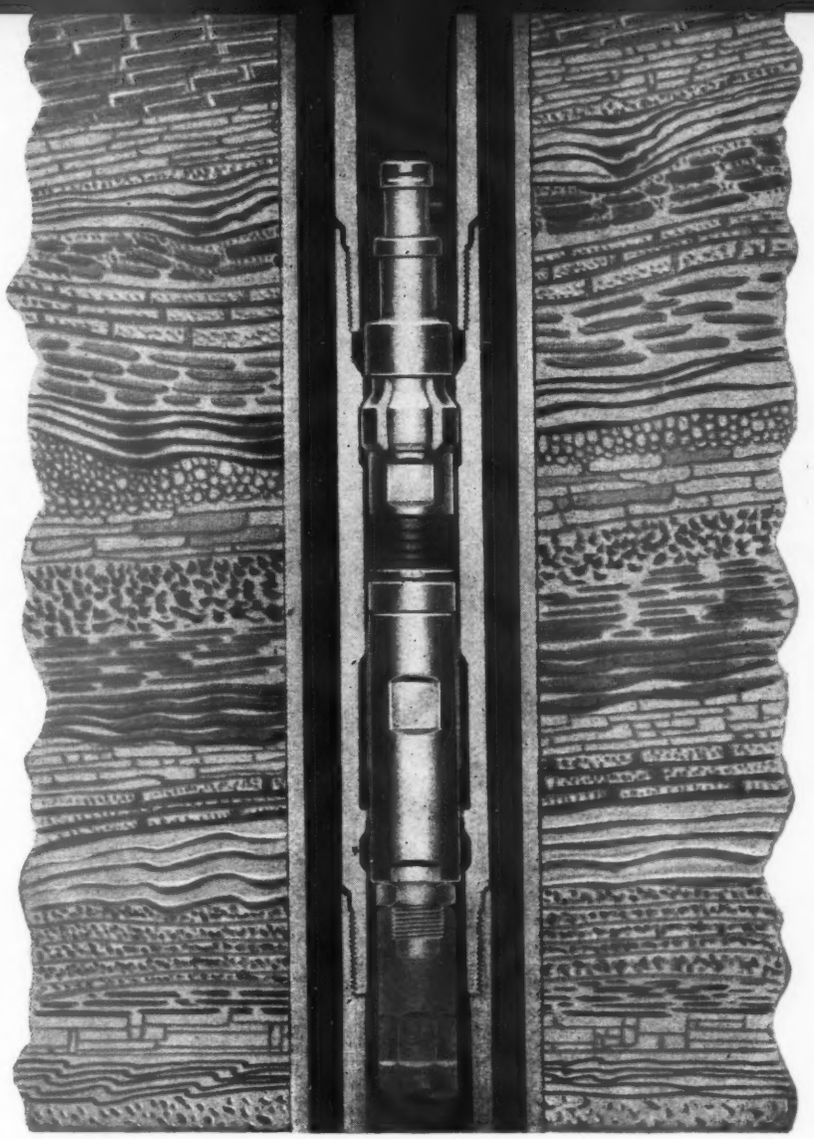
A. C. Stutson, Socony Vacuum Oil, New York, continues as head of the applications group.

A. A. Hardy, of W. C. Norris Company, Tulsa, is appointed publicity secretary for the coming year.

Plans are now being formulated for the Annual Petroleum Division Conference, to be held this year in Tulsa, Oklahoma. It is possible that over 40 technical papers, dealing with mechanical design problems of the petroleum industry will be presented.

Book Named President Of New York Nomads

The New York Chapter of Nomads elected new officers at its regular meeting last month. They include: Howard B. Book, president; Al Dill, vice president; Fred J. Jobst, secretary; Arthur Harvey, assistant secretary; John D. Evans, treasurer; George I. Lynch, assistant treasurer; Russ V. McIntire, sergeant-at-arms; R. (Bob) E. Elmore, assistant sergeant-at-arms; Henry V. McIntire, regent; Kenneth D. Demarest, regent.



Hamstring High-Pressure Problems

before they occur

"Keyed" Landing Nipples and Locking Assemblies

for Otis Sub-Surface Pressure Controls

Operators sometimes call this Otis down-well equipment "selective" nipples and mandrels because of a "keyed" locating and locking principle that provides a safe and positive method of installing Otis production tools in as many as five different places in the same string of tubing. As high-pressure wells are being completed, or when tubing is rerun after repairs, one or two—or as many as five—corrosion-resistant Type S Otis Landing Nipples can be made up as part of the tubing string. When required later, Otis Removable Bottom-Hole Chokes, Regulators, and Tubing Safety Valves attached to a "selective" locking assembly can be run in (on a wire line, under full shut-in well pressures) and set at the desired depth in the string. Each "keyed" locking device, and the production tool it carries, will pass through all upper landing nipples until the mandrel "selects" its correspondingly-keyed nipple. Contact your nearest Otis engineer for complete details and illustrated technical literature. *Otis Pressure Control, Inc., Box 7206, Dallas; field offices in* Houston, Corpus Christi, Victoria, Falfurrias, Longview, Odessa, Oklahoma City, New Iberia, Houma, Brookhaven, and Caracas, Venez.

Otis—outstanding in the Industry for pressure control

More than

5,000,000

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BRIGGS & STRATTON

GASOLINE ENGINES

The performance record of more than five million Briggs & Stratton single-cylinder, 4-cycle, air-cooled engines speaks for itself.

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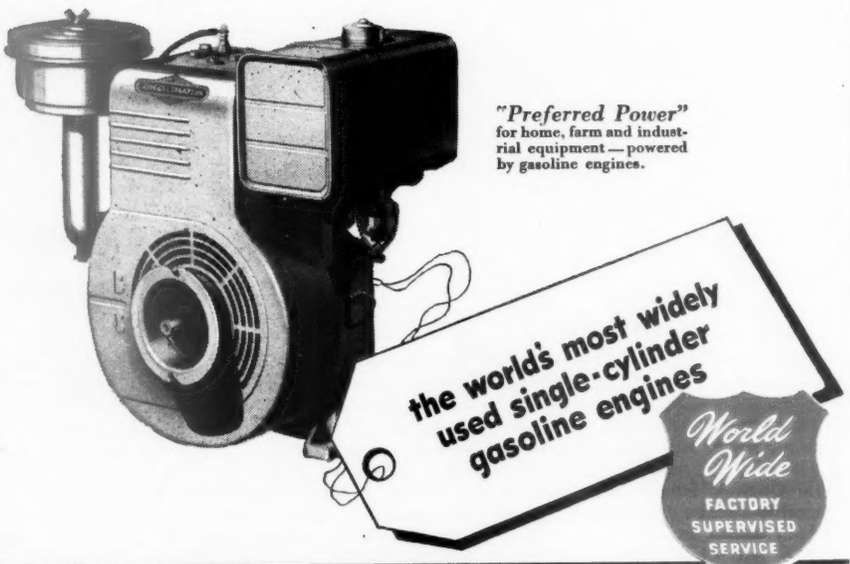


"Preferred Power" for home, farm and industrial equipment — powered by gasoline engines.

In the automotive field Briggs & Stratton is the recognized leader and world's largest producer of locks, keys and related equipment.

Saudi Arabian 1950 Output Totals 199,546,638 Bbl

Crude oil production in Saudi Arabia during December amounted to 19,154,039 bbl, or an average of 617,872 bbl per calendar day, it was announced by the Arabian American Oil Company. This compared with 18,602,809 bbl in November, an average of 620,094 bbl per calendar day.

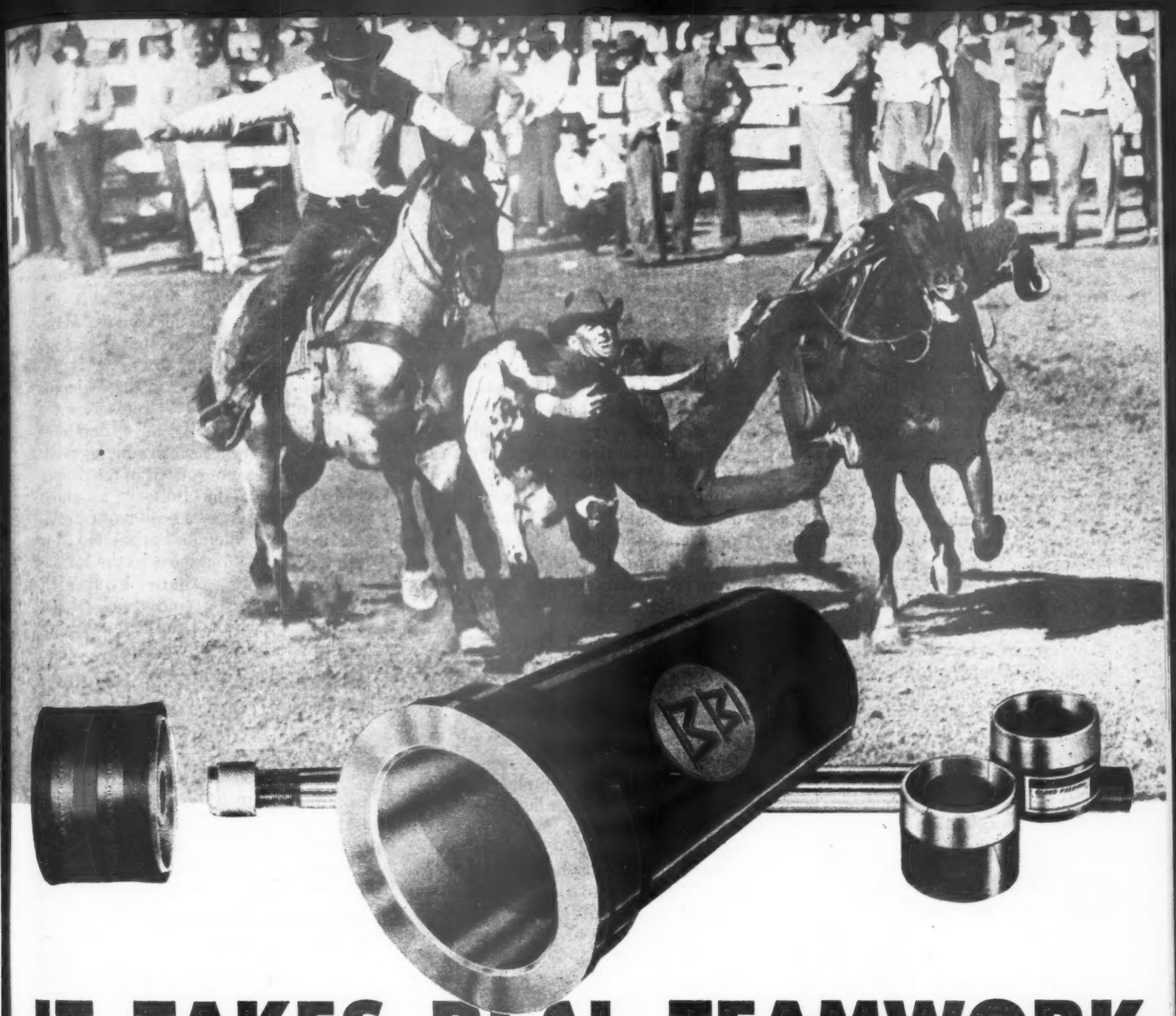
Crude oil production for the year 1950 amounted to 199,546,638 bbl, an average of 546,703 bbl per calendar day.

Petroleum Pioneers Hold Final 1950 Meeting

Sam Bowlby, vice president of the Shell Oil Company, wound up another year of Petroleum Production Pioneer history at the Rodger Young Auditorium in Los Angeles, California on December 2, when about 600 members gathered for their final meeting under the Bowlby aegis.

Among pioneer oil men honored during the evening were R. R. "Dick" Smith, 44 year man with National Supply Company before he retired a few years ago; I. T. "Cad" Cadwell, former drilling foreman for The Texas Company; the Lehman brothers, Jake of the Maricopa Boiler Works, retired, and Julius, still with Standard in the Inglewood area; Elmer Bolton, once production chief for Ohio Oil Company in Southern California; Al Tietze, former superintendent of production in the San Joaquin Valley for Standard of California; Ben Blanchard, old time Union Oil man; R. E. Stearns, vice president of Universal Consolidated Oil and current honorary president of Petroleum Production Pioneers; Len Little, first honorary president of the organization, and former Standard Oil executive; John Augsburger, retired McCrate Oil production superintendent; Lawrence Baash, partner in the Baash-Ross Tool Company; F. C. Ripley, former president of C.C.M.O., retired; A. E. Fowks, ex-Union Oil official, who has more oil service than any other man in the organization, and two sons, Al and Ernie, who both qualify as pioneers.

Also present were W. M. Brown, well known Standard Oil Company production man, retired; Frank Dinger, Union Tool Company, now National Supply Company, retired, reputed to have made the first serviceable drilling jars that were used in California; R. E. "Dad" Kline, formerly of Pacific Perforating Company, said to have taken the first kelly into Cat Canyon; and Jerry Kent, formerly of Kent and Whittier, which later became Richfield Oil Company.



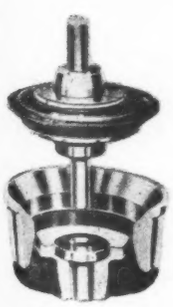
IT TAKES REAL TEAMWORK

to wrestle steers . . . and to assure *efficient* slush pump operation

Barehanded throwing of wild steers is so daring and dangerous a sport that it long ago became the "big wallop" of every rodeo. Successful steer wrestling demands precision teamwork by hazer, wrestler, and horses.

Efficient slush pump operation also requires precision teamwork. Piston, Rod, Liner and Packing must be in perfect alignment, have perfect fit, and work together with perfect mechanical precision! Valves must be rugged and efficient.

We have perfected the new MISSION "Super Service" Liner . . . accurately bored, ***induction*** hardened to ***uniform*** case thickness, precision honed, and "Satin Finished" . . . to enable you to obtain the same top quality in liners that you obtain in MISSION Pistons, Rods, Packing and Valves. These products constitute a perfectly mated "MISSION team" of expendable slush pump parts, ***unbeatable*** for economical slush pump service. Your supply store handles them . . . Mission Manufacturing Co., Houston, Texas. Export: 30 Rockefeller Plaza, New York. European Address: London, England.



Mission Silver Top Valve for Normal Pressures

Mission Super-Service Valve for High Pressures

MISSION MANUFACTURING CO

WHAT'S DOING IN DRILLING

Drilling in Canada May Be Lowered in 1951

Drilling activity may be reduced somewhat in 1951 in Canada by the steel shortage, according to some reports. Number of drilling rigs in operation dropped about 10 per cent in the early part of January, however, average footage per well is rising as the relatively shallow Redwater field development is slowing down and other deeper fields are expanding along with an increased wildcatting program to depths below 5000 ft.

Canadian Delhi Oil Company is conducting a substantial drilling program directed specifically towards the discovery of natural gas. Its record has been unusually high, with 6 successful completions out of nine wildcats, and open flow rates of up to 6,000,000 cu ft per day indicated. Most of the discoveries have been in Viking or Basal Cretaceous sand zones. No close stepouts have been drilled for evaluation of reserves.—L.O.R.

New Oklahoma Pool Confirmed By Gulf

Gulf Oil Corporation has confirmed the deep one-well Northeast Bradley pool in Grady County, Oklahoma with completion of its No. 1 Mainka Ring Unit. A drillstem test was run between 12,182 and 12,222 ft with tool open one hour. Air appeared immediately and flowed through the test. When the tubing was pulled, water and oil appeared. Full recovery was 830 ft of 41.3 gravity oil, 420 ft of oil and gas-cut mud, and 160 ft of load water.

Tyron Pool Extended

The growing Northwest Tyron pool of Lincoln County, Oklahoma has been extended by The Texas Company. The No. 1 Lewis, on the northwest side of the pool, has been completed from the Red Fork sand. Testing perforations at 4125-32 ft, above plug-back depth of 4179 ft, the well flowed 46 bbl of oil in 24 hours through a 25/64-in. choke.

Texas Drills New Well In Bowes Field, Montana

The Texas Company has a new well in Bowes field, Blaine County, Montana. It is the company's Cole No. 1, which flowed 106 bbl of oil in 6 hours after acidizing Ellis, topped at 3009 ft. Testing is still in progress.

Mississippi Field Has Well in Eutaw Formation

The Ovett field in Jones County, Mississippi has its first well in Eutaw formation. It is the Ginther-Warren and Ginther No. 1 L. L. Major, which is one and one-half miles northwest of the discovery well for the field. Initial production at the No. 1 Major was 85 bbl of 10-gravity oil per day pumping from perforations placed in Eutaw formation at 7348-80 ft. Approximately 20 bbl of light oil were injected into the hole, from which 80 were recovered. Testing is continuing in an effort to increase production.

Socony-Vacuum Drills Second Canadian Well

Socony-Vacuum Oil Company has a second producer in Canada known as Socony-Duhamel No. 29-14. The first one, the discovery well of the Duhamel field, was completed in October, 1950. It lies 40 miles southeast of Edmonton, Alberta. The second well, now being completed, is situated 2 miles north of the discovery well. Its total depth is 4870 ft, and oil was found at two different levels. The deepest and most prolific of these was topped at 4720 ft, with 124 ft of oil section below. Rate of flow from the lowermost level has been as high as 1750 bbl of oil per day through a half inch opening.

B-A Completes 2 Wells In Logan County, Colorado

The British-American Oil Producing Company, wholly-owned United States producing subsidiary of The British American Oil Company Limited which recently completed its Koenig and Ashby No. 1 well in Logan County, Colorado, has now completed two additional oil wells in the same general area. The British-American-Yenter No. 1 well on an 8-hour test before being shut in for tank room flowed 402 bbl of oil, a flowing rate of 1206 bbl per day. The British-American No. 1 Ramey well before being shut in for tank room swabbed 275 bbl of oil in 12 hours.

Crude from these wells is sweet crude of approximately 40 deg gravity and is being produced at approximately 150 bbl per day under proration. Present indications are that this discovery is one of the most important, if not the most important high gravity fields in northeastern Colorado.

German Field Has New Producing Zone

The Suderbruch field in the Hamburg district of northwestern Germany has a new producing zone. Well No. 8 has been completed in the Valendis sand of the Lower Cretaceous for about 400 bbl daily at a depth of 3600 ft. The other six producing wells in the field are completed in the deeper Cornbrash of the Jurassic at about 6750 ft. Shows have been made previously in the Valendis but the No. 8 is the first to be completed in the formation. The field is shared by Brigitta (Standard Jersey and Shell), and Vacuum. Present production is approximately 1000 bbl per day.

Wyoming's 1950 Oil Output Is Under Total for 1949

Wyoming's total oil production in 1950 was 851,973,000 bbl, according to a report issued by the Wyoming Commerce and Industry Commission. Largest year's production was 55,032,000 bbl in 1949. At that date the number of producing wells in the state was 4916.

Colorado Test Well Produces More Gas

More gas has been recovered at the Thornburg test, Mofatt County, Colorado, by Continental Oil Company. The well, Lewin No. 1, recovered gas in the Weber and is now down in Morgan formation. Weber was topped at 4005 feet and up to 2,000,000 cu ft of gas has been recovered.

The same company is still testing at its Unit No. 1 in Montrose County. The new well had gas shows in Paradox topped at 5109 ft.

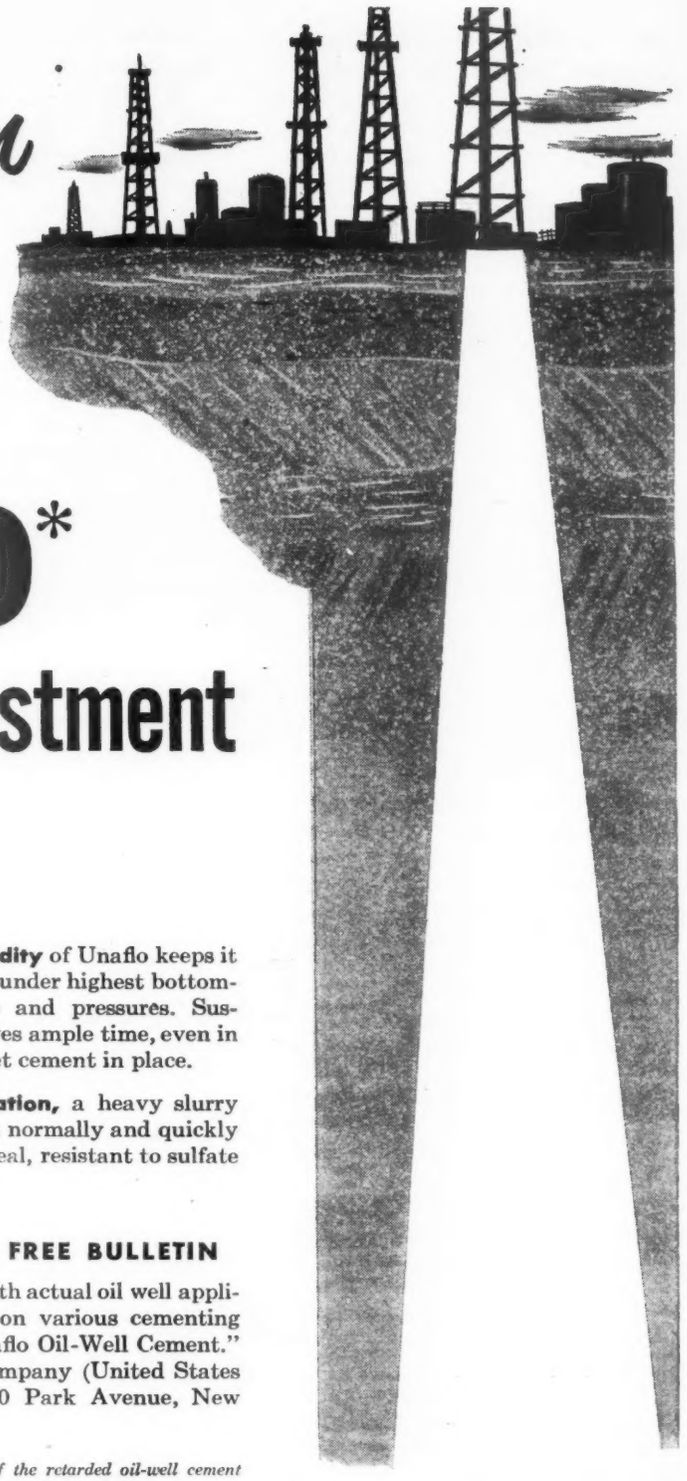
Diehl Well Flows 400 Bbl in 24 Hr

A producer flowing 400 bbl of oil in 24 hours from open hole between 4009-4120 ft has been completed in the Northwest Tyron pool, Lincoln County, Oklahoma. The well is situated in the Red Fork sand and is Ray P. Diehl's No. 3 Dodson.

Bishop Well Brought In

Bishop Oil Company has announced that it has brought a second well to production in Runnels County, Texas. On initial test, the well flowed for a potential of 152 bbl of 43 gravity crude per day. It was drilled to a depth of 4393 ft.

When you're 'way down deep...



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protects your investment 3 ways

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1. High initial fluidity of Unaflo makes pumping easier, permits use of heavy slurries when they are needed.

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3. After retardation, a heavy slurry of Unaflo hardens normally and quickly to form a dense seal, resistant to sulfate waters.

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Technical information backed up with actual oil well applications. Easy-to-follow diagrams on various cementing operations. Get your copy of "Unaflo Oil-Well Cement." Write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, New York.

**"UNAFLO" is the registered trade mark of the retarded oil-well cement manufactured by Universal Atlas Cement Company*

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Resistant to Sulfate Waters
Atlas Portland Cement—Type I
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"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

Low Carbon Steel Finds Greater Use in Oil Fields

The need for resistance to the corrosive action of fluids encountered in the condensate type of oil well has led to a rapidly increasing use of low carbon 9 per cent nickel steel (AISI "2800" type) for tubing. In addition to its corrosion-resistance, the high strength and toughness of this alloy steel makes it a logical replacement for N-80 carbon-manganese or manganese-molybdenum steel tubing in such wells. Typical properties, after normalizing and tempering treatments, are:

Tensile Strength, psi.....	120,000
Yield Strength, psi.....	100,000
Elongation in 2 in., per cent	30
Izod Impact, ft lb.....	70
Fatigue Endurance Limit (polished specimens), psi	70,000

The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania, has been a pioneer in the application of this low carbon nickel steel to oil well tubing, and has supplied a large tonnage of it to the petroleum companies under trade name "Nicloy 9."

Eight and one-half or 9 per cent nickel steel was originally developed to fill the need for a steel that could resist embrittlement at sub-zero temperatures down to —320 F, and has been successfully employed in this type of application, particularly in the form of welded pressure vessels. However, as a result of its resistance to corrosive oil well fluids, as demonstrated by field tests, a major tonnage is now being produced in the form of tubing.

In a 13,000 ft well in Louisiana recently, some 12,000 ft of B & W Nicloy 9 tubing, 2⅜ in. O D, was employed. Its combination of strength and corrosion-resistance aided materially in bringing this record-making well into production.

Nicloy 9 has also been adopted for sucker rods in certain types of wells where corrosive conditions tend to cause early fatigue failures with ordinary sucker rod materials.—Nickel Topics.

New California Well

Hancock Oil Company of California and Bishop Oil Company have a second successful oil well in the northeast end of Cuyama Valley field, California. The well is near the firms' discovery well of last August. It is the No. 33-31, which was completed with a flow of 430 bbl a day of 38.8 gravity oil through a 26/64-in. opening in the pipe. It was drilled to a total depth of 5974 ft, and tested at a depth of 5855 ft.

Dutcher Sand Extended In Oklahoma Pools

B. B. Blair has a Dutcher sand extension well in Creek County, Oklahoma, where his No. 1 Leonard has been completed from 2857-65 ft, flowing 75 bbl per day. The well is between the Southeast Mannford and Bruce pools. Blair's No. 2 Thompson struck the Dutcher sand at 2800-10 ft and flowed 62 bbl of oil per day.

Texas Pool Has Second Producer

A second well has been completed in the Big Sandy Marble Falls lime pool of Stephens County, Texas. It is the Whittmer-Knight-Ewing No. 1-A Ila Norvell, which produced 130 bbl daily through 12/64-in. choke with gas-oil ratio 876 to 1. Production is from 3717-34 ft. Hydrafrac treatment was given.

Sunray Well Drilled In Louisiana Field

Sunray Oil Corporation has completed a new well in the Benton field, Bossier Parish, Louisiana. The well flowed 398 bbl 36.7 gravity crude from the Bodcaw sand at 8148-61 ft. It produced from open hole on a 16/64-in. choke. Tubing pressure was 900 psi, and casing pressure was 1650 psi. Gas-oil ratio was 1732-1.

Shell Extends Iowa Field

The Iowa field, Jefferson Davis Parish, Louisiana, has been extended northward with completion of Shell Oil Company's No. 1 Iris Leger. The well flowed 280 bbl of 38.5 gravity oil daily through a 7/64-in. choke from 10,396 to 10,444 ft. Tubing pressure was 4900 lb and gas-oil ratio was 2000 to 1.

Peruvian Fields Deepened

Empresa Petrolera Fiscal, the Peruvian Government oil organization, has failed to find oil by drilling deeper in the old Zorritos concession.

Dunlap and Graham, Long Beach, California contractors, drilled the well to 6800 ft. It is the first in a 10-well program to be carried out by the government. The government concession extends from the north edge of International Pertoleum's Ltd. producing area and has a daily output of 340 bbl from shallower wells.

Adds Well In Pondera Field

General Petroleum Corporation is installing pump at its Martin 5-18 in Pondera field in Montana. The well swabbed 123 bbl of oil in 16 hr, cut 16 per cent with water. Total depth is 1907 ft. The first well on the Martin lease pumped 163 bbl oil in 24 hr.

New Oil Zone Found In Kentucky Pool

George S. Engle has a new producing zone at the Zion North pool in Henderson County, western Kentucky at his No. 1 Harding Heirs. Prospective zone is the Aux Vases, with saturation logged at 2198-2201 ft. In the test the well began flowing gas within 15 min and clean oil within 100 min after the tool was opened. The hole has been deepened to 2351 ft in McClosky lime, main producing zone.

Sun Has New Field Well

Sun Oil Company has a new well in the Velma pool of Stephens County, Oklahoma, the No. 4 Robinson, drilled to a depth of 5333 ft. With 7-in. casing set at 5220 ft, the well flowed 597 bbl of oil in 24 hr.

Ashland Drills Field Well

Ashland Oil and Refining Company has a second well in the Southeast Waterloo pool of Oklahoma County, Oklahoma. The company's No. 1 Wilson, tested in the Bartlesville sand between 5977 ft and 5992 ft, flowed 110 bbl of oil in 22 hours through a 24/62-in. choke.

Auger Drilling Replaces Compressed Air in Canada

Use of compressed air in shot hole drilling by seismograph exploration crews has not proved satisfactory in certain areas in Canada. The method was also tried on water holes. Auger drilling has supplanted the air method in these areas as a more satisfactory alternative to mud drilling.*

The technical problem encountered in most of the holes that were air-drilled is that a sticky formation is encountered that balls up and muds off, making completion impossible even with the largest economic size of compressor. Contract crews in Saskatchewan have had trouble with compressed air in cases where a high water table exists in the ground. Conversely, the same soft ground conditions that caused trouble with the air method appear to be well suited to auger drilling. These soft strata are typical of a large part of northern Canada.

A rig has been designed** in collaboration with field suppliers that consists of an attachment to fit present drilling rigs at a fraction of the cost of conventional units. It is stated that a rig can be changed over to auger use or back to drilling mud use in about half an hour. Two rigs were reported working with these attachments at the end of the year.—L.O.R.

*Seismic Service Supply Ltd, Calgary
**by Mayhew Machine and Supply Co.

Operators say it's TRUE!

When experienced operators say "Lane-Wells does a dash-blank good perforating job," there's an opinion worth listening to. And experienced operators in every field — veterans and smart younger men — do say just about that.

Some of these canny old-timers have been using Lane-Wells services for nearly 18 years; according to them, there's no substitute for experience. Lots of younger operators, too, find that the experience gained in over 143,000 perforating jobs helps a lot on their jobs — so they use Lane-Wells perforating.

Not all operators feel that way. We never claimed to bat 1.000 all the time. Even Ivory soap says only, '99-44/100% pure': perfection costs *more* than anyone can afford. But Lane-Wells batting average is, and always has been, in the high 900's. And lots of operators like Lane-Wells service because we don't alibi if something does go wrong, because we do our best to make it good. Ask your Lane-Wells man about

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EXPLORATION ACTIVITIES

Magnolia Drills Deepest Gulf Coast Producing Well

Magnolia Petroleum Company has discovered the deepest producing Gulf Coast well brought in to date at its No. 1 Doornsbos-McPherson, 35 miles north of Lake Charles and in Beauregard Parish, Louisiana. The well, is rated a daily potential of 1512 bbl of 45.3-gravity oil, is flowing through 15/64-in. and 12/64-in. chokes. Gas-oil ratio is 2537 to 1.

Drilled to a total depth of 14,573 ft, the well is producing from the Eocene-Wilcox area. Location is a mile north of the Hurrican Creek field where production is at shallower depth.

Opens New Era Field In Adams, Mississippi

R. J. Bartlett and Barnett Serio have completed their No. 1 George W. Armstrong, to open the New Era field of Adams County, Mississippi. The well is pumping at the rate of 85 bbl of oil and 30 per cent salt water per day. The well was completed at 6325-27 ft opposite sands of the McKittrick zone of the Wilcox series. Gravity of oil being produced is 41.8 deg. Hole was drilled to total depth of 6761 ft and cased with 5½-in. pipe to 6440 ft after Schlumberger log and side wall samples indicated commercially productive sands in the Wilcox.

Continental Gets First Ship Shoal Area Well

Continental Oil Company has made the first oil strike in the Ship Shoal area of the Gulf of Mexico, about 15 miles off-shore from Terrebonne Parish, Louisiana. The well, the company's No. B-1, has been completed with an initial daily production of 510 bbl through a 3/16-in. choke. Partners in the operation with Continental are the Magnolia Petroleum Company and the Newmont Oil Company. The well produced 37.2 gravity oil from perforations at 10,948-54 and 10,960-66 ft. Tubing pressure was 1970 lb, gas-oil ratio 1000. Total depth is 11,978 ft.

Reef Lime Well Brought In

Sunray Oil Corporation has discovered a new well from a Pennsylvania reef lime in Dawson County, Texas. Drillstem test of 1.75 hours from 9502 to 9530 ft, total depth, recovered 7450 ft of 40.9 gravity oil, 120 ft of drilling fluid and 60 ft of salt water. Oil in drillpipe was calculated to be 121 bbl.

Tests Indicate New Gas Field in Utah

The California Company, a wholly-owned subsidiary of Standard Oil Company of California, has reported tests of an exploratory well in Uintah County indicated discovery of a new natural gas field, which may prove to be a major Utah gas reserve.

The well, Red Wash Unit No. 1, 18 miles southeast of Vernal, struck a gas zone at 4166 ft, with further shows to the present depth of 4472 ft. Tests at various levels in this interval have indicated production rates of 2,000,000 to 20,000,000 cu ft of natural gas per day. Core tests are being continued.

Location of an important gas reserve in the area would be particularly significant because it is less than 150 miles from the Salt Lake City industrial area. It is only 7 miles from the route of a crude oil pipe line currently supplying the new $15,000,000 refinery of the Salt Lake Refining Company and other oil plants in the Salt Lake Area.

Nebraska Well Completed

Ohio Oil Company has completed its No. 1 State in Cheyenne County, Nebraska for 8,800,000 ft of gas a day from the first Dakota sand zone at 4802-29. Total depth is 5410 ft with pipe set at 5407 ft. The well is situated 2½ miles southeast of the McCauley-Dorough gas discovery in Cheyenne County.

New Well in Garvin County

Cities Service Oil and Ohio Oil Companies have a new wildcat, No. 1 Hatcher, in Garvin County, Oklahoma. The new well topped the Bromide sand at 4589 ft and ran drillstem test at 4570-95 ft. With tool open only 27 min, the well flowed oil at the end of 23 min, and it reportedly made fluid at the rate of 10 bbl per hour.

Abandoned Well Reopened As Successful Producer

The Superior Oil Company has opened Gibson sand production in an abandoned wildcat in Garvin County, Oklahoma. Rendering the abandoned well, Superior's No. 1 McDaniel, at a total depth of 12,549 ft, drilled and cleaned out to 8203 ft where casing was set. Following Hydrafrac treatment of perforations between 8115 and 8116 ft, the well was finaled on the pump for 70 bbl of 40.2 gravity oil daily.

Kansas Strike Is Big Gas Flow

Jomilson Producers No. 1 Light "B" is the chief center of attention in Seward County, Kansas. On latest test through perforations between 6020-30 ft, the well is reported to have flowed gas at an estimated rate of 50,000,000 cu ft a day with 500 bbl of distillate a day, through 2-in. tubing. A rank wildcat, the well is east of the east edge of the vast Hugoton gas field. Elevation is 2748 ft. A log shows 13-in. casing was set at 585 ft and 8-in. at 2305 ft. On test between 5900-6007 ft, with tool open 12 min, gas flow was estimated at 5,500,000 cu ft a day and recovery was 340 ft of gas-cut mud and 10 ft of distillate.

Mexico May Have Rich Oil Strike

Northeast Mexico may develop into a rich new oil field, E. W. Pauley, oil man, has reported. Pauley based his opinion on oil bearing formations discovered 5 miles south of the Rio Grande in the state of Tamaulipas, where the Intex Oil Company is conducting drilling operations. Tests of the gas flow indicated gas production would run more than 3,000,000 cu ft a day, enough to supply Mexican users and market some across the border to the U. S.

Kerr-McGee Has New Pool In Banner County, Nebraska

A new oil field has been opened in the Denver-Julesburg basin of Western Nebraska, Banner County. Pool opener is Kerr-McGee Oil Industries and Associates No. 1 Mead. The well recovered 4220 ft of free oil on drillstem test of the Lower Muddy sand at 5880 to 5907 ft. Casing was to be set immediately. The said zone was topped at 5879 ft. The well showed an estimated 300,000 ft of gas a day when the testing tool was opened, and it headed oil several times when the tester was being pulled.

Gant Well Is Opener

Walter Gant has discovered a new oil pool in Love County, Oklahoma, with completion of his No. 1 Liddell 3 miles east of Marietta. The well produced 10 bbl of oil an hour on a ¼-in. choke, and is 2 miles from the No. 1 Reed, also developed by Gant. The No. 1 Liddell is producing from the Deese sand at 5498-5516 ft.

Continental Well Flows Oil and Helium Gas

A twin flow of oil and helium gas in the Table Mesa field on the Navajo Indian reservation in the Northwest corner of New Mexico has been found by Continental Oil Company. The new discovery, Table Mesa No. 17, was drilled as a deep exploratory test in the Table Mesa field. This field has been fully developed as a shallow oil field, with pay no deeper than 2000 ft. Total depth of the new strike is 7751 ft and perforations have been made from 7450 to 7533 ft, in the Ouray limestone.

The well was completed with a 24-hr flow of 190 bbl of 52 gravity oil and 9,100,000 cu ft of gas through a 38/64-in. choke. The gas has a high content of nitrogen, which will not burn and is commercially worthless.

Special significance is attached to the new well because it is producing an unsually high per cent of helium. Current tenseness of international affairs places an accent on helium in view of its uses in World War II.

Second lightest of the known elements, and valuable because it is non-inflammable, helium was used extensively during World War II in blimps for ocean convoy duty, etc.

New Production Found

Sun Oil Company has opened new production in Calcasieu Parish, Louisiana with completion of its No. 1 Dr. W. F. Brooks. The well flowed 150 bbl of 46 gravity oil daily through an 8-in. choke from 10,868 to 10,880 ft. Tubing pressure was 2400 lb.

Two-Zone Field

C. W. Murchison et al has opened a 2-zone field north of the Pegasus field in southwestern Midland County, West Texas at the No. 1 Cannon and Lunt. The well flowed 360 bbl of oil in 26 hr through a 2/64-in. choke from the Ellenburger at 13,190 ft. It was then perforated in the Pennsylvanian at 10,465-530 ft and flowed 311 bbl of oil in 7 hours through a 20/64-in. choke.

Canadian Wildcat Successful

Canadian Gulf Oil Company has completed its C. P. R-Collins No. 7 wildcat, a well situated near the center of the 18-mile stretch separating Gulf's Stettler and Big Valley oil fields, Canada. The wildcat drilled into basal Cretaceous sand at 4166 ft and halted for drillstem test 8 ft in the sand at 4174 ft, with packer set at 4162 ft. tester was open 65 min. After 18 min a flow of natural gas at rate of 500,000 cu ft daily reached the surface. Gravity of a 525-ft column of crude oil is about 30 deg.

Utah Has Big Gas Flow

A natural gas flow that will run between 5,000,000 and 10,000,000 cu ft daily has been discovered on the Monticello structure near Monticello Utah, Byrd-Frost, Inc. has reported. The firm said the gas would be piped to the Salt Lake City area if permission is granted for the construction of a transmission line. A drillstem test from 5738 to 5831 ft in the No. 1 Sitton, disclosed a flow estimated at more than 5,000,000 cu ft per day from the upper Paradox formation.

Standard Will Allot More Money to Exploration

Standard Oil Company of California and its domestic subsidiaries will spend $41,500,000 during the first six months of 1951 in exploration work and oil field development to get more crude oil to meet civilian and military petroleum demands. This was reported by T. S. Petersen, Standard's president, who said the expenditures will be 14 per cent more for these purposes than in the same 1950 period.

Petersen said that if the present demands continue, the companies would spend approximately $80,000,000 on exploration and development for the entire year of 1951.

"Finding new production is particularly important in California, which, because of its geographical location, has been providing better than 50 per cent of the oil being supplied from the United States to the military services," he explained.

Petersen pointed out that during the last 10 years the domestic production of the company and its subsidiaries had risen from about 103,000 bbl daily to more than 275,000 bbl daily last year.

Gardner Pool Find Made

A new Gardner sand oil pool has been opened in Runnels County, Texas. The Richard King and Henry I. Flinn No. 1 Hale was completed to flow 101 bbl of 43 gravity oil daily flowing from open hole producing from 3455 to 3471 ft. The pool is one mile northwest of Talpa, Texas.

Louisiana Field Opened

A new oil field has been opened in Beauregard Parish, Louisiana three miles northwest of the Bear field. It is the Fidelity Oil and Royalty Company's No. 1 Edgewood Land and Logging Company which is credited with having recovered considerable amount of 36.9 gravity oil on a drill stem test from 8543 to 8558 ft. Top of the sand was reported to be 8543 ft and the bottom was 8566 ft.

New Zone in East Texas

The second producing zone has been discovered in the Woodlawn pool in Harrison County, Texas. It is at the Hollandsworth Oil Company's No. 2 Frank Davis. Situated 2 miles west of production, the Hill zone in the test was cored, with the top of the Rodessa section from 5647 to 5690 ft, carrying some gas. On a drillstem test, there was gas at the surface in 15 min, with the well flowing through a ½-in. choke on bottom and ¼-in. choke on top. The Pettit zone has been the only producing zone thus far.

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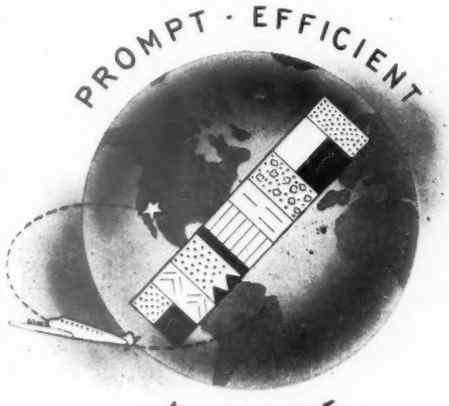

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Running tour with men in the industry

Paul E. Haralson

Paul E. Haralson, Magnolia Petroleum Company, has been advanced to superintendent of Magnolia Petroleum Company's land department. He succeeds the late **Ralph Talley** in that position. Talley had been with Magnolia for more than 31 years and was land superintendent for 27 years.

James M. Henagan, Jr., has been promoted to petroleum engineer II and transferred from Lake Charles, Louisiana to Shreveport, for Magnolia. He will be engaged in reservoir and evaluation work in the Shreveport producing division.

Emil C. Pela, petroleum engineer in the Healdton producing district, has been transferred to the Lake Charles district with headquarters at Mamou.

J. G. Litherland, Jr., has been transferred from the Falfurrias producing district to the West Texas division with headquarters at Midland, Texas. He will be engaged in reservoir and evaluation work for the West Texas producing division.

Roy R. Morse, regional director of exploration for Shell Oil Company, Houston, Texas, has retired after 26 years of service with the company. Widely regarded as one of the leading geologists in the country, Morse joined Shell in California in 1925 and was transferred to the company's Houston office in 1935 as exploration manager. In 1944 he was named manager of the Texas-Gulf area, with responsibility for general planning and coordination of the exploration, production and land departments. In 1946, he became director of exploration for the company's East-of-the-Rockies region, a post he held until his retirement. Morse received from the College of Mines, University of California, a B.S. Degree in 1913 and a Ph.D. in 1923.

Jack Abernathy, Big Chief Drilling Company, Oklahoma City, Oklahoma, has been elected chairman of the Central Oklahoma Chapter of American Association of Oilwell Drilling Contractors for 1951. He succeeds **Earle C. Flesher,** Johnson and Flesher Drilling Company.

Other chapter officers elected recently, include: **George B. Kitchel,** vice-chairman and **W. R. Ewert,** secretary, both with Kerr-McGee Oil Industries, Inc., Oklahoma City.

William S. Frisbie, Frisbie and Yancey Drilling Company, Tulsa, was elected chairman of the Tulsa Chapter of AAODC at a meeting held in Tulsa. He succeeds **B. E. Groenewold,** Exploration Drilling Company, Tulsa. **A. R. Olson,** Olson Drilling Company, was elected vice president, and **Robert D. Snow,** H and S Drilling Company, was elected secretary and treasurer.

Kenneth Huffman, district engineer in the Sohio Petroleum Company's Owensboro, Kentucky, office has resigned from the company. Huffman has been engaged in water flood engineering and operations for the past 3 years and has been with the company for nearly 7 years. He will do consulting engineering work and will specialize in water flood studies and operations. He will continue to headquarter in Owensboro.

P. M. Berry, General Petroleum Corporation's production engineer in the San Joaquin division, Bakersfield, California has been named resident engineer in the southern production division at Los Angeles. He replaces **Claude W. Pierce,** who has been named superintendent of water disposal. **William Alexander, Jr.,** engineer in the San Joaquin division, was named resident engineer.

Allen Cree, assistant division geologist for Cities Service Company, Casper, Wyoming has been transferred to the newly established offices for the Montana area at Billings. **P. M. Model** has been named scout for the area.

Milton Frank Reedy, Jr., has been named chief geologist for Republic Natural Gas Company, Dallas, Texas. Reedy is a graduate of Southern Methodist University and the University of Texas, and has been associated with Crown Central Petroleum Company, Houston, Texas.

John H. Wilson

John H. Wilson, vice president and manager of Independent Exploration Company's North Texas office in Fort Worth, resigned January 1 to open his own office as a consultant specializing in exploration programs. He will serve Independent Exploration Company as a consultant.

David B. Campbell, with Independent for 15 years and former supervisor of the Fort Worth office, is moved up to the position of district manager. He will be assisted by **George H. Harrington, Jr.,** who has also served in Independent's Fort Worth office for several years.

Roland Dunkerley, Houston, Texas, has joined Housh Drilling Company, Houston. **Dunkerley** has most recently been associated with the British American Oil Company, as drilling superintendent and district engineer. Prior to that he worked for the Humble Oil and Refining Company in the land and geological department, Corpus Christi, and in the production department at Freer, Texas. Following this he went to A. & M. College, graduating in 1942 with a degree of petroleum engineer.

Thomas J. Bevan has announced the opening of offices as a consulting geophysicist at 809 Palace Building, Tulsa, Oklahoma. He will specialize in gravity interpretation.

Jack Wilson, Amerada Petroleum Corporation scout in Jackson, Mississippi, was recently elected president of the Mississippi Oil Scouts Association for 1951. Other officers include: **Paxton Robertson,** Sun Oil Company, vice president; **L. C. Farrington,** Ohio Oil Company, secretary; **H. LeRoy Francis,** Carter Oil Company, treasurer, and **Ray Stevens,** Shell Oil Company, editor.

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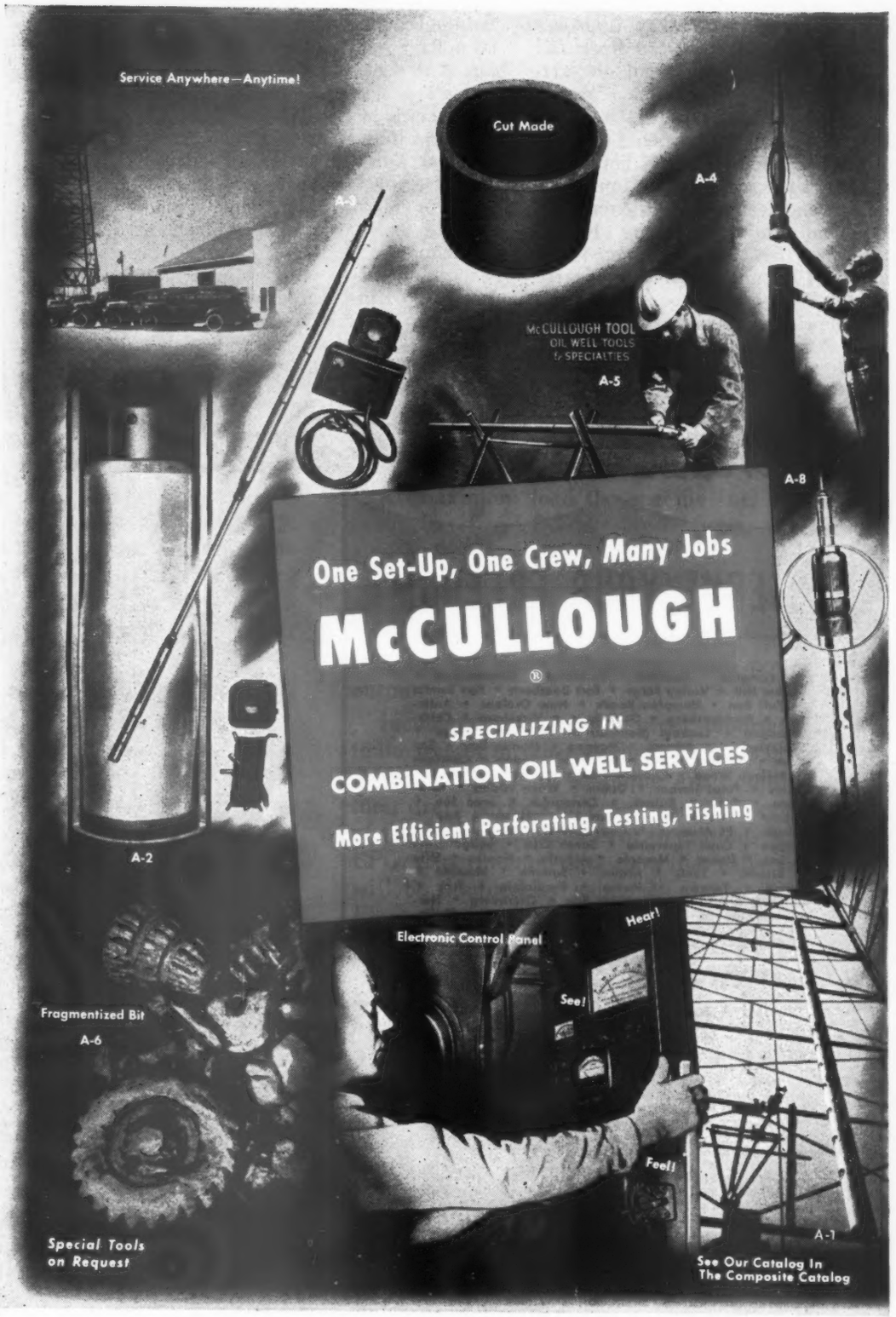

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▸ **Castle J. Harvey** has been appointed manager of Deep Rock Oil Corporation's geophysical department. Harvey's professional career has taken him over most of the United States and Korea. He entered the University of Illinois in 1923 but quit a year later to visit Korea as apprentice mining engineer for the Oriental Consolidated Mining Company. He returned to the States, re-entered Illinois in 1929 and received his degree in 1932.

Following graduation, he worked for a time with the Indiana Highway department, then accepted a job with the Geophysical Research Corporation and gained his first contact with oil in the Southwest. In 1935 he transferred to Amerada Petroleum Corporation's geological department, joining Atlantic in 1943. He held successively the jobs of geophysical coordinator at Tulsa, geophysical supervisor first for Oklahoma and Kansas then for Mississippi, Alabama, and Florida and geologist for northern Oklahoma.

▸ **C. H. Mims,** United Geophysical Company party chief has moved to the Middle East area to head a new seismic party, which began operations in December.

▸ **George W. Murphy,** junior petroleum engineer, British-American Oil Producing Company, has been promoted to petroleum engineer, and

George W. Murphy

transferred from Oklahoma City to Houston, Texas. He replaces R. P. Dunkerly, formerly petroleum engineer for the Southern district. An Oklahoma A and M graduate, Murphy joined British-American in 1948, during which time he has been doing engineering work in Wyoming and the Oklahoma City area.

▸ **W. F. Bates** has been appointed general drilling superintendent of Shell Oil Company. He will replace **C. S. Penfield** who is retiring the first of the year after more than 35 years with Shell. Bates was graduated from Stanford University in 1933 in engineering and joined the company soon afterwards as a roustabout. Two years ago when Shell announced the successful completion of a deep well portable drilling rig, Bates was in charge of the project.

▸ **Alexander Clarke, Jr.,** has been named division engineer for Stanolind Oil and Gas Company's North Texas-New Mexico division it was announced by John R. Evans, division manager. Formerly assistant division engineer, **Clarke** succeeds **R. W. Collins** who has resigned. Clarke received a B.S. degree in petroleum engineering from Texas A. & M. College in 1940 and joined Stanolind in May of that year.

Succeeding Clarke as assistant division engineer will be **T. M. Curtis.** Curtis was formerly district engineer for Stanolind in Midland and he has been with the company since 1941. He received a B.S. degree in petroleum engineering from the University of Texas in 1939. **J. C. McCarthy** has been named district engineer at Midland, replacing Curtis. McCarthy moves to Midland from Tulsa, Oklahoma, where he was petroleum engineering supervisor in Stanolind's office. He joined Stanolind in 1940 after receiving a B.S. degree from Pennsylvania State College in 1939.

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LIQUEFIED PETROLEUM GAS has been the problem child of the oil and gas industries for the better part of a generation. High volatility, huge availability, great heat value, outstanding anti-knock ratings, all are possessed by this (in many cases) waste product in extraordinary degree. Huge sums have been spent to develop and install equipment for the removal of propane and butane from natural gasoline and from refinery "recovery" gasoline to reduce those products to vapor pressures consistent with their purposes.

Now the industries are converting this liability material to an asset, and the number of useful outlets, and the amounts consumed by them are increasing by leaps and bounds. Total LPG consumption for 1950 has been estimated at 231,000 bbl per day as compared to about one-eighth of that amount 10 years ago. With a demand increase of some 177 per cent since 1945, the product is expanding its applications about as fast as the mechanical phases of its utilization can be 'perfected'. Besides "bottled gas" for heating and cooking purposes in homes and small installations, and in larger quantities for fuel makeup in municipal and industrial fuel gas systems, the two oldest and largest applications to date, it is being used for refrigeration, air conditioning, dryers, and washing machinery, and somewhat more recently in one of the most promising of all outlets, that of internal combustion engine fuel. The subject is of sufficient importance to warrant the Society of Automotive Engineers' devoting an entire session to a symposium on the developments.

One primary consideration in using LPG for tractor and other engine fuels on farms and elsewhere is the fact that compression ratios can be higher than for conventional motor fuels. Maximum compression ratio for pure butane is about 8 to 1, as compared to approximately 6.5-7 to 1 for leaded motor fuel. Engines so designed for LPG have an important mechanical advantage. For pure propane this ratio may be 9 to 1 or higher. Ratios for commercial LPG may range between these values, the matter depending on the percentages of propane and butane in the fuel.

At maximum load the specific fuel consumption for LPG is up to 18 per cent greater than for motor fuel; at lighter loads LPG consumption is considerably lower than for gasoline, even 91 octane number gasoline; butane consumption is less than motor fuel for all loads below maximum power output.

Incidental advantages of great importance to the tractor or other engine user especially is that farmers for example are doubling their drain periods on crankcase oil because of the extreme cleanness of operations with LPG. Experimental data show that valve life will be doubled by using the lighter fuel. Plantation owners find that they have a saving of 20 per cent or more in unit maintenance cost, with LPG fuel. Maintenance costs of LPG regulator and carburetor equipment have been "very small", reports M. J. Samuelson of Minneapolis-Moline Company.

Because of the greater specific fuel consumption of LPG a price differential must exist between motor fuel and the light fuel, to compensate for this disadvantage. Current delivered prices of LPG fuel for farm tractors, etc. are about one-half to two-thirds of motor fuel prices, after deducting the gasoline tax from the latter, which more than compensates for the 18 per cent greater consumption. Drawbacks are that it appears desirable to utilize top lubrication for LPG-using engines, and that in severely cold weather starting is somewhat more difficult; this last objection is expected to be eliminated by improvement in fuel system design.

Refiners and natural gasoline manufacturers may realize importantly in the near future on this development.—A.L.F.

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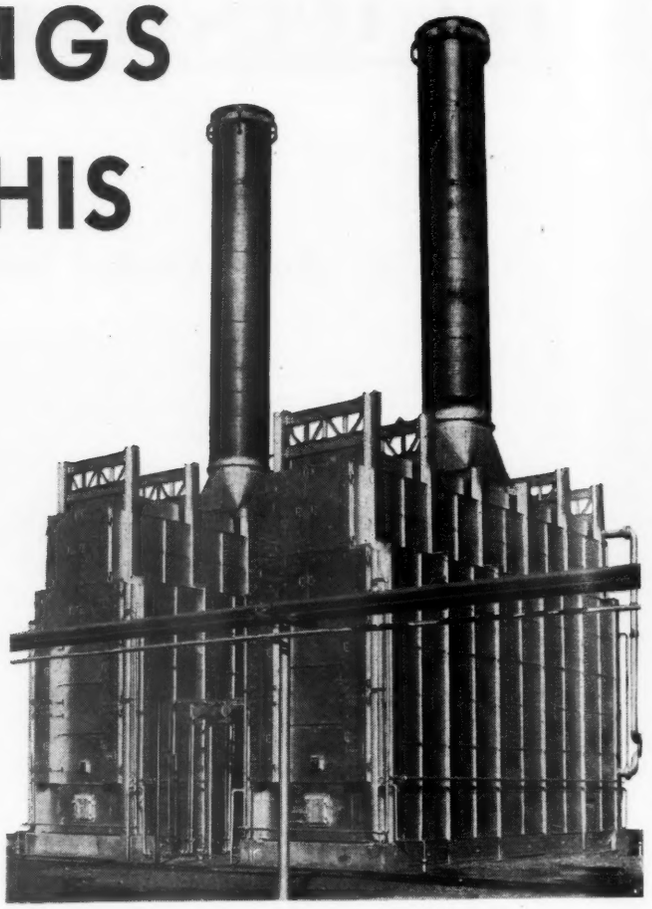

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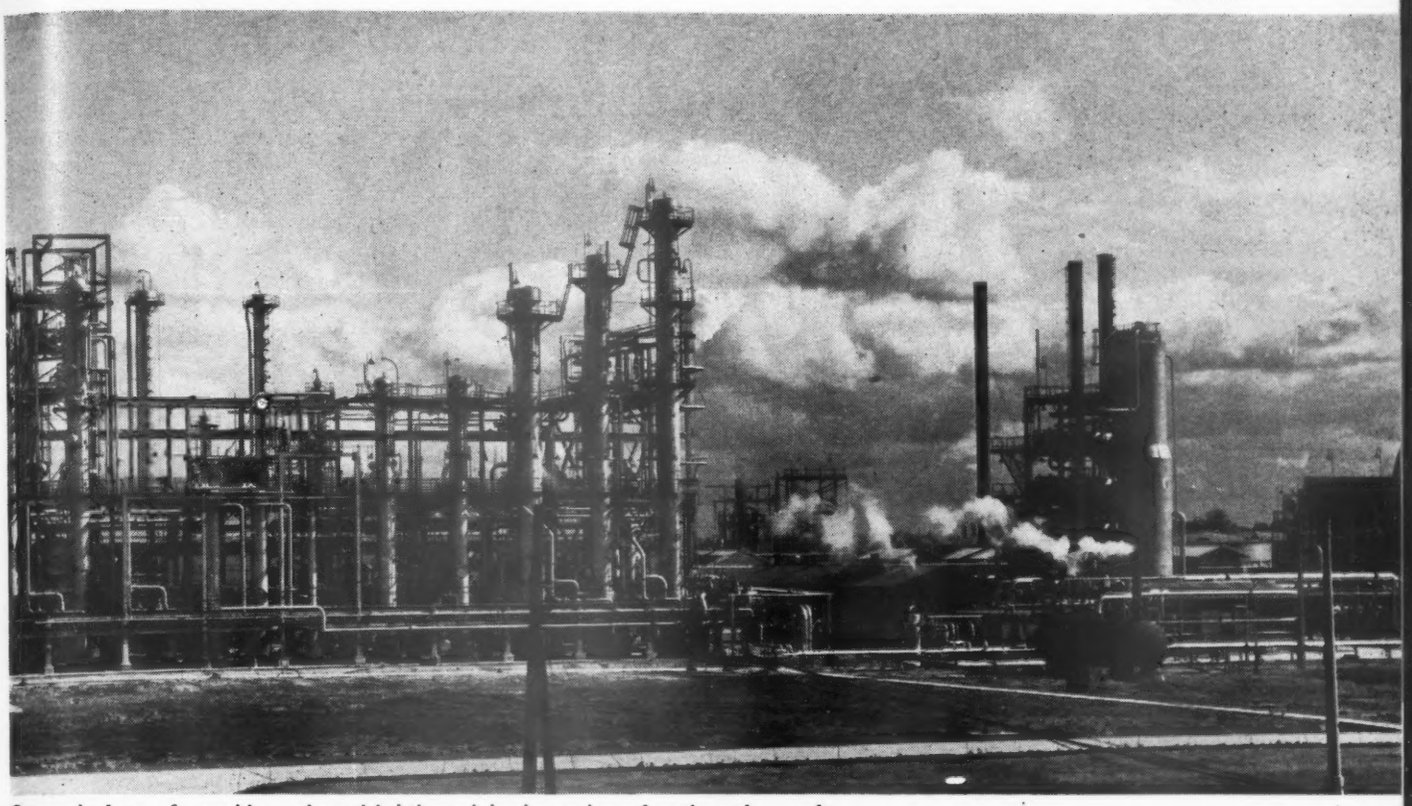


General view of cracking plant (right) and hydrocarbon fractionation unit.

Outstanding Petrochemical Plant in England

Shell plant at Stanlow is expanding to employ fractionation, cracking, hydrogenation, polymerization, and synthesis in making chemicals by methods similar to those used in Holland and the U. S.

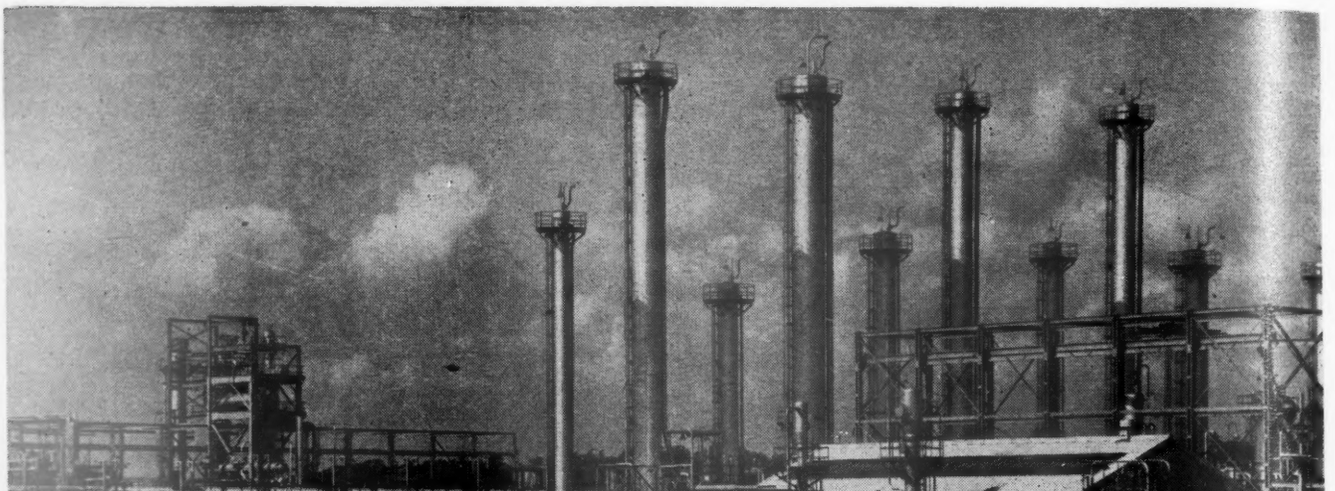
V. S. SWAMINATHAN

STANLOW, on the south side of Manchester Ship Canal, was chosen by the Royal Dutch-Shell group in 1922 as a site for discharging oil cargoes and storing imported oil. A bitumen plant was erected shortly afterwards. During the past decade progress was rapid, partly in response to general industrial expansion and in part to imperative war demands. Among products turned out were iso-octane and a full range of lubricants. The latter were made by the Edelenau process using one chemical solvent and the Duosol process employing two solvents. Manufacture of the synthetic detergent (Teepol) from the wax by-product of the Duo-Sol process marked the first stage from traditional oil business to the production of "chemicals." Plans to build a chemical plant took concrete shape in 1945. Later it was decided to erect a large refinery to refine full crudes and also manufacture the usual range of bulk products.

The vast experience gained by the Shell group over many years in research and design is embodied in the new units at Stanlow, making them among the most up-to-date plants of their kind in the world. Design of the plant is almost wholly American though Dutch engineers have also played a part. The solvent production plant is modeled on Shell's own units in U.S.A. Some of the specific designs were provided by the Shell Development Company at Emeryville, California, the others (apart from the acid concentration plant made by Simon Carves) were made by the American firms, Stone and Webster Engineering Company, the Girdler Corporation, C. F. Braun and Company and the Lummus Company. The first of these was also responsible for the design of the initial gas separation plant.

American concerns also acted as main contractors for several of the units, with these exceptions—Head Wrightson Processes, Ltd. were contractors for the gas separation plant. W. J. Fraser and Company for several

EXCLUSIVE



Pressure storage tanks and part of the reaction unit behind which can be seen fractionating towers of the distillation unit.

of the solvent production units and Foster Wheeler, Ltd. (a British affiliate of the American concern) for the distillation unit. Most of the actual equipment itself was fabricated in Britain; but some compressors were of Dutch design and manufacture. Most instrumentation control is of American design, but is now made by the U. S. firm—Foxboro—in Britain. Lastly, those running the Stanlow chemical plant have the advantage of experience in plants of the Shell Chemical Corporation.

To sum up, the new plant starts with great assets, and under very favorable sponsorship. It can draw on one of the most fruitful experiences in the American industry where work of the Shell Chemical Corporation holds an honored place. It is assured of continuous interchange of scientific knowledge and practical "know-how." Amsterdam, center of much of the fundamental research of the Shell group (for example, into the basis of catalytic action) will contribute as well as Emeryville and Thornton. Finally, experience in new Dutch plants of the group making Teepol and polyvinyl chloride plastics will be available as well as American experience in a much wider field.

The Stanlow plant consists essentially of a thermal cracker together with units specially designed to deal with cracked products by fractionation, hydrogenation, and polymerization, synthesis and distillation, as well as a number of reactors and converters. The operation is continuous with control highly centralized and automatic. Therefore production per worker will be among the highest of any undertaking in Britain.

The basic raw material of the plant is gas oil. It is cracked under carefully controlled conditions of high temperature and low pressure to give a high yield of hydrocarbons containing three and four carbon atoms. These fractions include a very high proportion of the olefins, propylene (C_3 stream), and butylene (C_4 stream), which on separation form feedstocks for the manufacture of solvents and other chemicals produced at Stanlow.

The new Stanlow refinery now under construction alongside existing plants is designed to refine 2,000,000 to 2,500,000 long tons a year of crude oil, mainly from the Middle East, and when complete is expected to provide the requisite feedstocks without the necessity for special cracking. Complete integration of refining operations and chemical manufactures as already achieved in America will then be possible here.

The thermal cracker converts gas oil into unsaturated hydrocarbons or olefins, necessary for subsequent processes. The gas oil is first vaporized in a furnace, the effluent vapors passing to two cracking furnaces operating at high temperatures. Steam is mixed with oil vapors as they pass through the furnace tubes, to assist in the vaporization of gas oil to prevent polymerization of hydrocarbon vapors and also to decrease coke formation in the tubes. The correct proportion of steam is essential for the maximum yield of olefins.

The cracking unit is designed to operate at maximum heat recovery and waste heat steam generators are incorporated in the process design to assist maximum heat utilization of all the oil side streams. The process is adjusted so that a very high proportion of olefins is formed. The furnace effluent vapors are fractionated in a large column from the base of which fuel oil residue is taken. The mixed hydrocarbon vapors pass overhead

India Has Plans For Oil From Coal

India soon will begin manufacture of synthetic petroleum from coal in an effort to end her dependence on foreign supplies, according to J. C. Ghosh, director of the West Bengal Higher Institute of Technology. He told an Indian science congress in Bangalore, India that a geological survey had discovered some 100,000,000 tons of coal in Bengal for such use.

from this column to the next section for the separation of individual units.

The effluent from cracking furnaces consists of a complex mixture of gases and vapors, whose components include a full range of hydrocarbons. The approximate percentage composition by weight of furnace products is given below:

Products	Per Cent
Hydrogen, methane, ethane, ethylene	28
Propane, propylene	17
Butane, normal butylene, *iso*-butylene, butadiene	11
Aromatic distillate	19
Fuel oil	25

The C_3 and C_4 streams contain a very high proportion of olefins forming the raw materials employed in the subsequent manufacture of several solvents. The efficient separation of this mixture into its individual components calls for very careful control and manipulation of flow rates, temperatures, and pressures. The method consists of a combination of absorption and fractional distillation principles. Part of the C_4s and all of the C_5s together with the heavier material are absorbed from the total hydrocarbon stream in an absorber. The resulting rich oil from the absorber then goes to a debutanizer, where the C_4s are taken overhead. The C_5 stream is recycled to the cracking furnace. The bottoms of the depentanizer consists of all the C_6s and heavy ends forming the aromatic distillate, part of which is utilized as lean oil for absorption and the remainder distilled. The distillate after hydrogenation is incorporated into motor fuel.

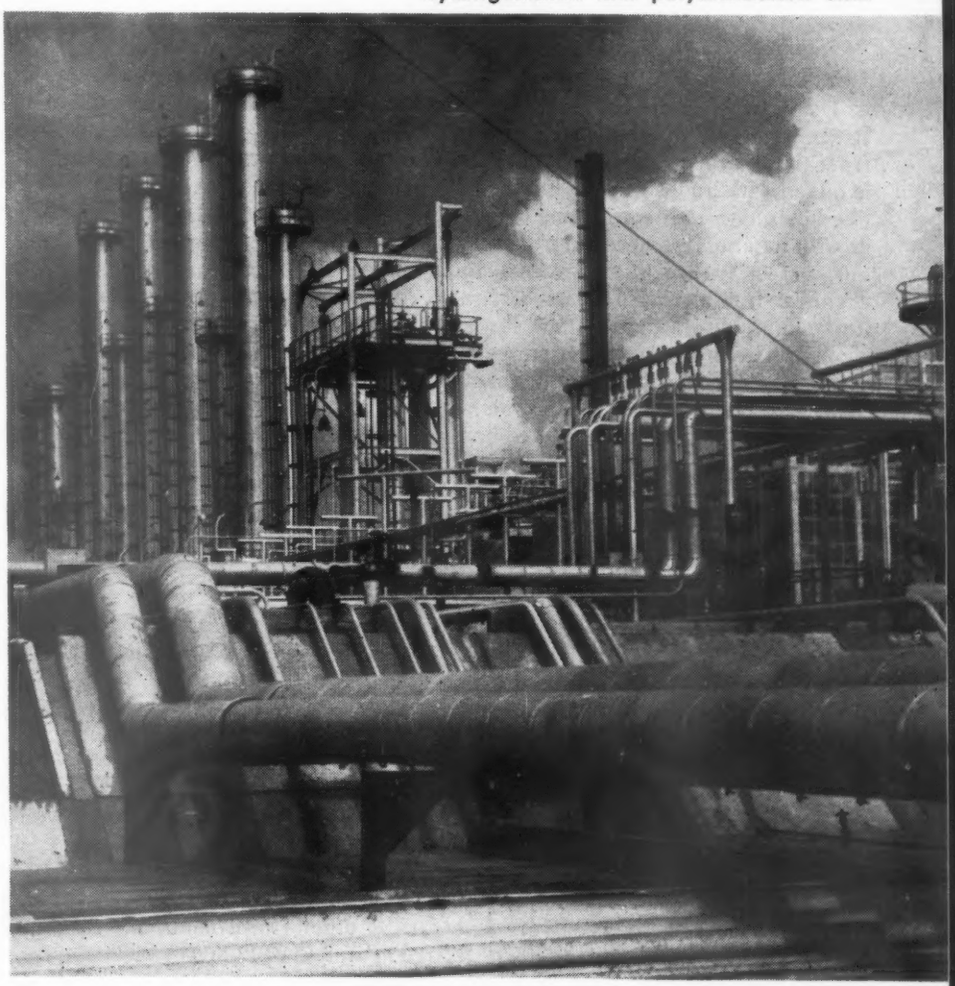
The lighter fractions from the top of the absorption tower, together with the C_4 stream from the top of the debutanizer, are split into individual constituents by fractional distillation under conditions of high pressure and low temperature, the latter entailing use of propane as refrigerant. Eventually obtained in a high state of purity, the C_3 and C_4 streams are employed in subsequent processes. All the constituents lighter than C_3 are burnt as fuel gas. Sulfur as hydrogen sulfide and mercaptans is an undesirable constituent of C_3 and C_4 streams. It is removed by passing the gases through a Girbotol treater, and a caustic soda wash system.

The C_3 stream is composed largely of propylene with propane as the chief diluent. The next step is transformation of propylene into isopropyl alcohol. The mixture of propylene and propane is treated with sulfuric acid, the proportion of which to hydrocarbon and temperature of the reaction is regulated so that virtually all propylene is absorbed by the acid to form the esters isopropyl hydrogen sulfate and diisopropyl sulfate. The unabsorbed hydrocarbon, largely propane, is separated from the acid layer and after distillation and treatment with caustic soda is fed to the fuel gas system. After separation the acid layer is progressively diluted with water to hydrolyze the esters that previously formed to yield isopropyl alcohol and sulfuric acid. The separation of alcohol from sulfuric acid is carried out in strippers where steam is injected to assist in distillation. At this stage the isopropyl alcohol is admixed with water and impurities such as isopropyl ether. To obtain alcohol of very high purity the crude product is subject to a distillation step involving careful use of several columns.

When isopropyl alcohol is passed over a suitable catalyst at high temperatures it is broken down into hydrogen and acetone. The former is highly pure and suitable for other hydrogenation reactions. The latter is separated from isopropyl alcohol and subsequently refined by successive distillation steps.

The preparation of methyl isobutyl ketone from acetone is carried out in three separate stages. The first is a condensation of the two molecules of acetone to form one molecule of diacetone alcohol. The reaction is carried out at low temperatures in the presence of a suitable catalyst. A partial separation of diacetone alcohol from unconverted acetone is effected by distillation. Pure diacetone alcohol is prepared by further distillation as required. The bulk of diacetone is converted to mesityl oxide by elimination of water from the molecule, a chemical transformation carried out in the presence of a dehydration catalyst at suitable temperatures, which forms stage two of the process. After distillation, to remove water, acetone, and unconverted diacetone alcohol the mesityl oxide is hydrogenated to yield methyl isobutyl ketone. In this final step mesityl oxide after vaporization is mixed with hydrogen and passed over a catalyst. Under favorable conditions a large proportion of the oxide is converted to methyl isobutyl ketone. Distillation is resorted to for obtaining pure ketone.

Fractionating towers of distillation unit and part of butadiene hydrogenation and polymerization unit.



View of plant from one laboratory showing fractionation unit through left window and cracking plant through right.

The useful component of the C_4 stream, normal butylene as received from the hydrocarbon separation unit is mixed with undesirable components like butadiene and isobutylene together with butane. It is necessary to carry out a feed preparation process by chemical treatment before commencing manufacture of secondary butyl alcohol. The normal butylenes are reacted with sulfuric acid and the resulting esters hydrolyzed to secondary butyl alcohol, which is separated and purified by a procedure similar to that described in the foregoing for isopropyl alcohol.

The conversion of secondary butyl alcohol to methyl ethyl ketone is also analogous to the corresponding preparation of acetone and is carried out in similar equipment. Secondary butyl alcohol, when heated and passed over a dehydrogenation catalyst, breaks down into hydrogen and methyl ethyl ketone. The ketone is separated from unconverted alcohol by distillation and purified by further distillation.

The sulfuric acid employed in the two alcohol reaction systems is collected from the bottom of the alcohol strippers in a diluted form. Tars and polymer impurities contained in it are separated and the acid reconcentrated to its original strength in two steps involving separate Mantius vacuum concentrators, carbon being removed after the first step.

The Stanlow units produce solvents of minimum 99 per cent purity, whose marketing specifications are essentially those of pure organic chemicals. Solvents now produced include isopropyl alcohol, isopropyl ether, acetone, diacetone alcohol and mesityl oxide from propylene, and secondary butyl alcohol and methyl-ethyl ketone from butylene. These products can be divided into three types, ketones, alcohols, and ethers, each with many industrial uses.

The ultimate raw materials used for solvent manufacture at Stanlow represent 28 per cent of the original weight of feedstock. Of the rest 19 per cent is in the form of aromatic distillates, which are now used after hydrogenation for motor fuel, and the balance is fuel oil or gas, which provides most of the considerable heat requirements of the whole chemical plant itself. The 28 per cent transferred to the solvent units is subject to further process losses as propane and other constituents are extracted. The weight of final solvents to be made is estimated at between 20,000 to 24,000 tons for a feedstock of 100,000 tons of gas oil.

The cost of the plant at £4,000,000 $11,200,000, is high in relation to turnover computed at around £2,500,000 ($7,000,000.) The average value of a ton of solvents made at Stanlow at current prices is approximately £100 ($280). The principal cost is that of gas oil, valued £9 a ton c.i.f. (before devaluation of pound sterling). Four tons of gas oil are required for one ton of solvent, which supplies the major raw material almost all the fuel for direct heating of furnaces; and fuel for steam used in processing and for compressors. In addition power is bought for 200 electric motors averaging 16 hp used in the plant. Other processing materials (sulfuric acid, caustic soda, catalysts, and the like) amount to 10 to 20 per cent of the cost of gas oil. Labor costs (direct, maintenance, and service labor including laboratory and administration) are very low, possibly less than 10 per cent of the material costs. Some reckon on obsolescence of plant of this type in, say, about five years. Those at Stanlow consider this a pessimistic estimate as there is considerable flexibility attached to proportions in which production can be made. * *

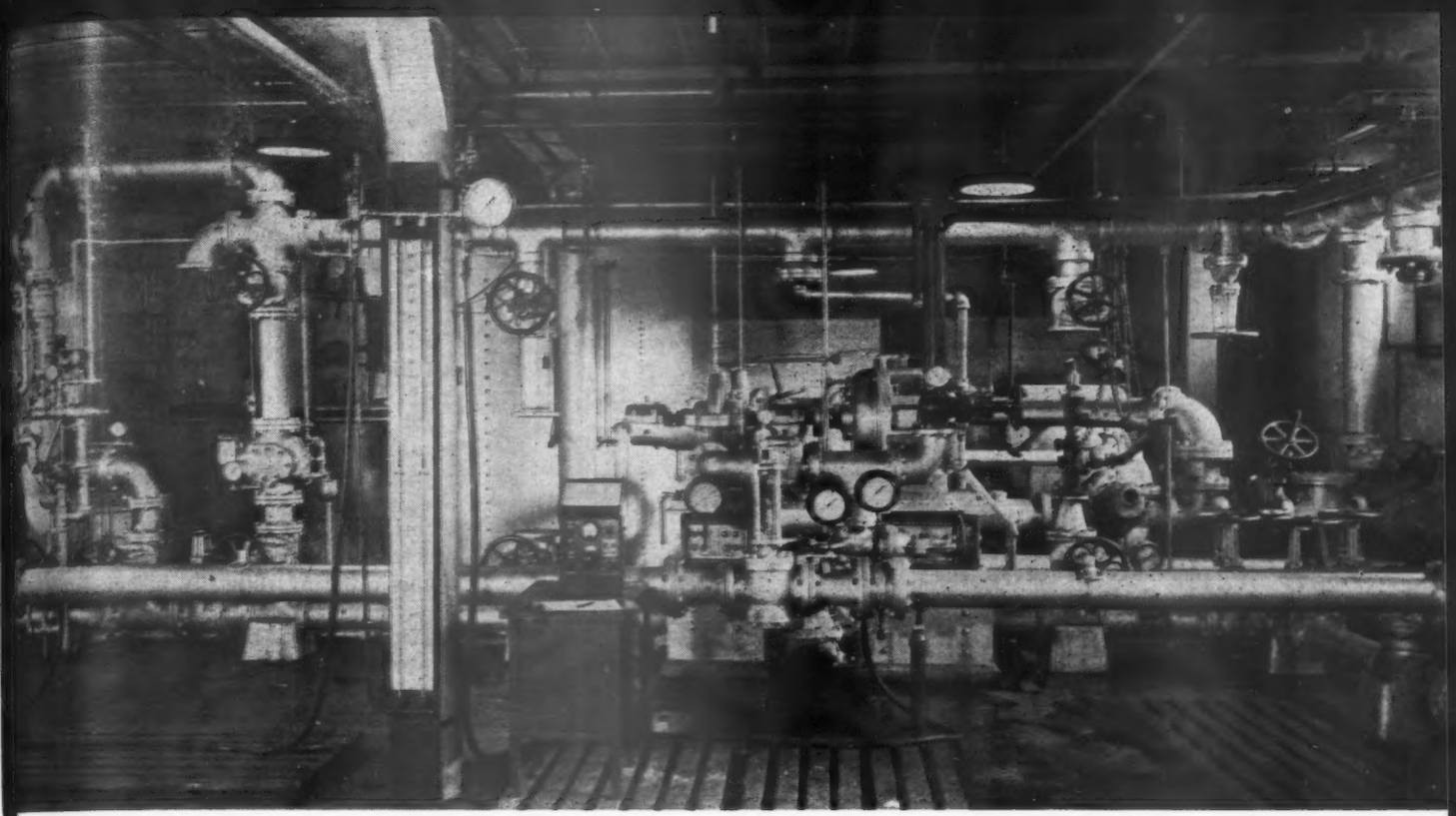


FIG. 3. Test laboratory.

Unbalanced Force Reactions in Control Valve Plugs and Their Influence on Diaphragm Motor Design and Operation*

RALPH A. ROCKWELL†

IN TWO PARTS—PART 1

THIS report on the net unbalanced force reactions in single and double seated valves is a summary from a series of tests and studies. The work has extended over a period of 8 years. In some instances the main test objective was to study some other characteristic such as rotational stem forces, valve capacity, flow characteristics, or cavitation, etc., along with net stem force reactions. The present material will be restricted in scope to present the subject in simplified perspective, allowing a more interesting discussion of the practical problem of control valve usage. Comparisons of forces with different type plugs will be made, with particular emphasis not only on the magnitude of the forces, but the force direction and its rate of change.

The particular problem is the application of present day knowledge about the behavior of control valve plugs under relatively high pressure drops to the selection of diaphragm motors. Special emphasis will be given to the behavior of conventional diaphragm motors and springless motors as applied to both single and double seated valves.

Although there are a good many things to be learned about the forces acting on valve plugs under high pressure drop, there are certain properties that can be examined qualitatively and quantitatively to give aim and purpose to the discussion.

For many years there has been a tendency toward oversimplification in analyzing the forces acting on valve plugs throttling flows at high pressure drop. Double seated valve plugs, for example, are loosely called "balanced". The only unbalance is generally considered to be the difference in seat areas. In single seated designs the only force generally considered is that occurring with the valve closed or very nearly closed. This force is simply the seat area times the differential pressure across the valve.

Although it is true that the double seated construction greatly reduces the net stem force, many valve plug designs in actual service are far from balanced. The force reactions for single seated valves are also relatively complex. Fortunately, a simple analysis can be made that clearly sets forth the important point to be considered in the understanding of the force reactions.

Single Seated Valves

First, consider the forces acting on a single seated valve plug. Such a unit in the simplest form is shown in Fig.

*Delivered at the symposium on Instrumentation for the Process Industries at the Fifth Annual Session, October 13, 1950, Texas A&M College, College Station, Texas.

†Director of Engineering, Mason-Neilan Regulator Company, Boston, Massachusetts.

FIG. 1. Valved tank with disc.

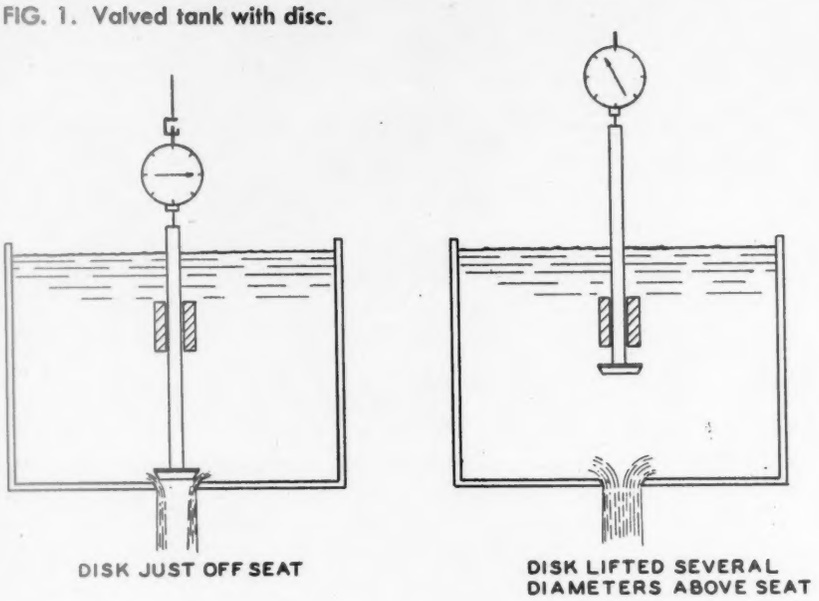
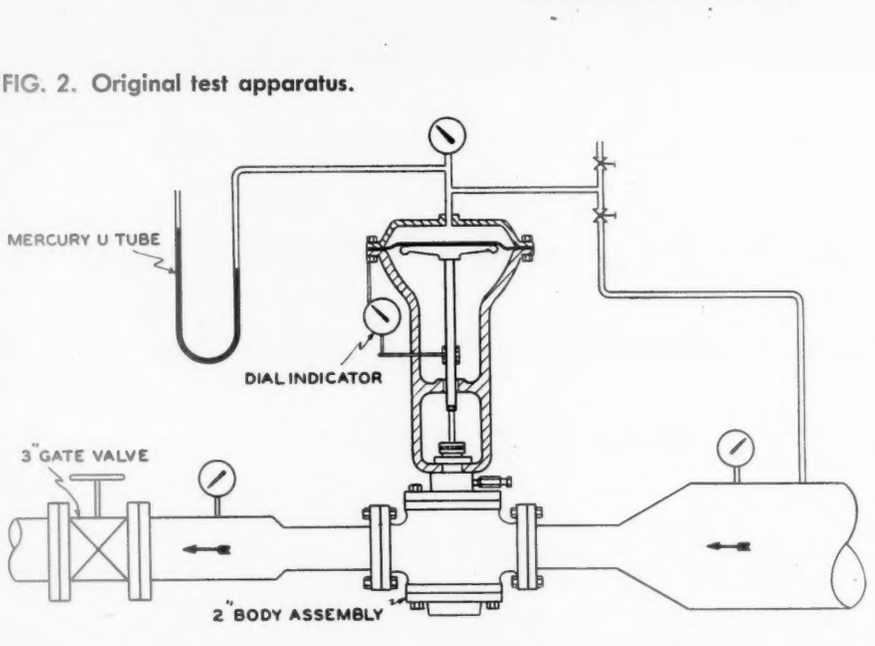


FIG. 2. Original test apparatus.



1. The round disc operates to open and close a circular orifice in the bottom of a tank of constant head and unlimited supply. With the disc very close to the seat, the force exerted on the plug, due to the pressure of the water is substantially the disc area times the net head. As the plug is withdrawn from the orifice this force diminishes, and in the second sketch with the disc several diameters out of the orifice the net force acting on the valve plug due to the fluid passing through the orifice is reduced to zero. This is an experience familiar to anyone operating the stopper in a bath tub, and it represents the key to the whole problem of valve stem forces. The problem lies not in consideration of the force acting on the valve plug near the closed position. but in the *change* in force throughout the stroke. In practical valve plug design, the change in force throughout the stroke varies with the design of both the plug and valve body. If the plug is lifted to the point where the flow is a substantial portion of the maximum potential flow the change in force will be a substantial portion of that existing near the closed position. This force change must be taken into account in the selection of a suitable motor operator.

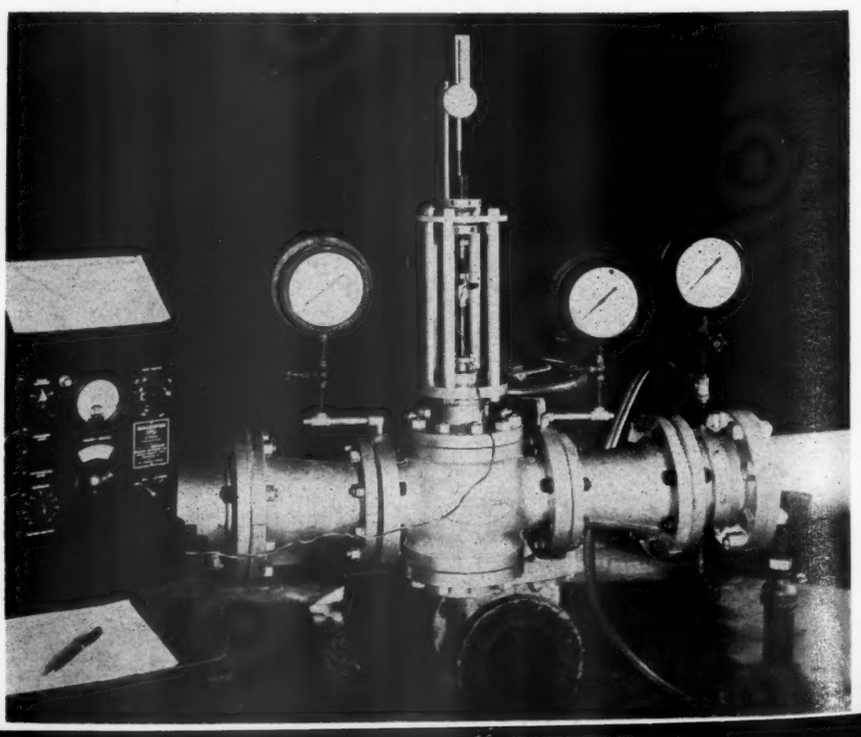
Although the force reactions in single seated valves are necessarily complicated, a series of tests conducted on several single seated valve plugs differing radically in construction makes possible some important generalizations. By treating double seated valves as a combination of two single seated valves operating in opposite flow directions, an important analogy is drawn between these two basic types.

Piping Installation and Test Equipment

The first studies of unbalanced forces were made in 1942, and Fig. 2 shows the test set-up. This work was done prior to the time when strain gages were generally available for industrial use. Net compressive stem force was measured by fluid pressure on a calibrated diaphragm. Although crude this arrangement provided the first quantitative unbalance force reactions on double seated valves, and permitted better evaluation of some of the difficulties encountered in field installations. Subsequent more accurate tests substantiated the results obtained to within accepted hydraulic test accuracy.

The major part of the later test

FIG. 4. Four-inch test valve and strain equipment.



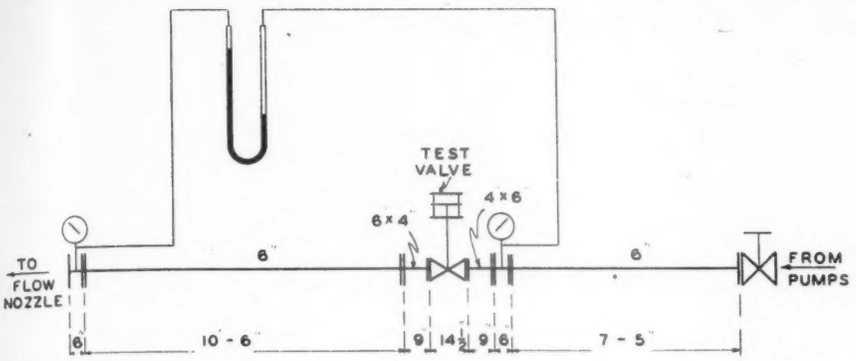


FIG. 5. Piping layout for 4-in. test valve.

work was conducted on water with the test equipment shown in Figs. 3 and 4. A 200 hp motor operated two DeLaval centrifugal pumps on the same shaft. The piping was arranged for either parallel or series pumping, providing a head of 160 psi at 1200 gpm, and 60 psi at 4000 gpm.

The test manifold for the 4-in. valves was 6 in. with 6 by 4-in. flanged reducers bolted directly to the valve. Six-inch gate valves installed upstream and downstream provided a means of adjusting both the static pressure and pressure drop across the test valve.

A scale layout for this manifold is shown in Fig. 5. The upstream and downstream pressure taps were taken from the 6-in. run using piezometer rings. The pressure drop across the test manifold was checked by removing the valve and bolting the two flanges of the manifold together. The piping was then tested for pressure loss and corrections applied to the test readings to give accurate pressure measurement existing at the inlet and outlet of the test valve.

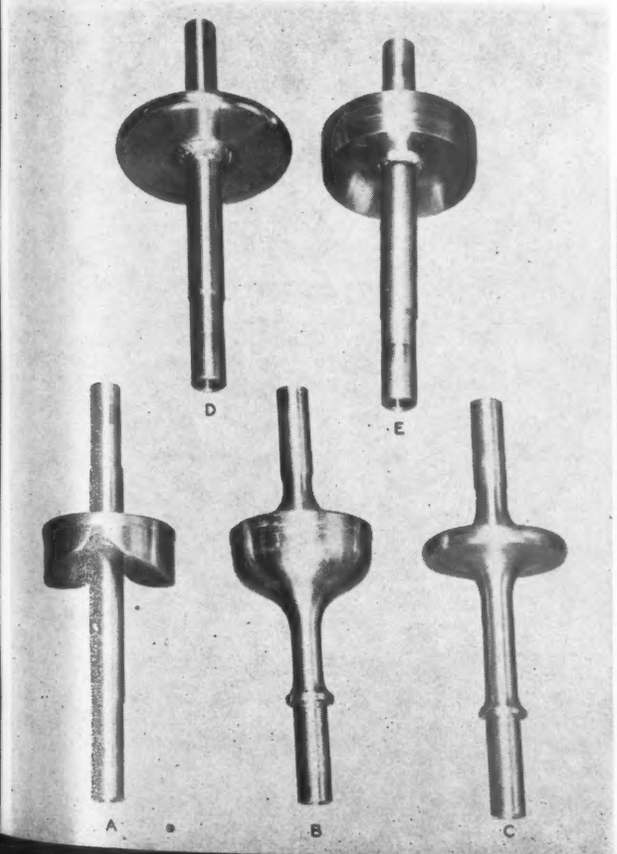
Flows were measured by a series of interchangeable calibrated open discharge flow nozzles, and the inlet nozzle pressure head by a well type mercury manometer. Test pressure gages were used for static pressures above 30 psi, and a mercury manometer for static pressure and pressure differential below 30 psi.

During the tests on the 4-in. valves it was impossible to maintain constant pressure drop of 100 psi at all lifts. A series of force readings were made at various lifts and the pressure drop was varied substantially. These readings were plotted to confirm the assumption that the developed force on the plug stem varies directly with the pressure drop through the ranges where this assumption was used. It was felt that this run was sufficient evidence to justify this procedure, and the plotted data has been corrected on this basis. Actual pressure drop generally varied from about 80 to 95 psi.

A fabricated steel superstructure was bolted to the valve bonnet, and the plug lift adjusted by two special lock nuts that held the plug stem in successive positions. Plug lift was measured from the seated position by a dial type micrometer gage.

Net stem compressive and tensile forces were measured by a strain gage unit, which was assembled as a part of the plug stem. The strain element was accurately machined from a piece of steel with a tubular section that gave the required sensitivity. Two SR-4 strain gages were cemented diametrically opposite on the tubular section. This arrangement, with a temperature compensating gage unit, permitted direct measurement of stem strain in micro inches per inch of gage length. The strain gage unit was calibrated in pounds load by a weigh beam before and after the test to check all components of the force measuring system. The force readings are well within plus or minus 5 per cent accuracy, which is ample for practical analysis.

Five different types of single seated plugs were tested in a 4 in. body (Fig. 6). Plug "A" is a percentage V-port with 2 ports. Plug "B" is a percentage parabolic plug with the same lift and flow coefficient as the V-port. Plug "C" is a quick-opening disc. Plug "D" is a special quick-opening overlapping disc, fabricated to study as an extreme case the force reactions as the disc



FIGS. 6 and 7. Four-inch single seated test plugs and four-inch double seated test plugs.

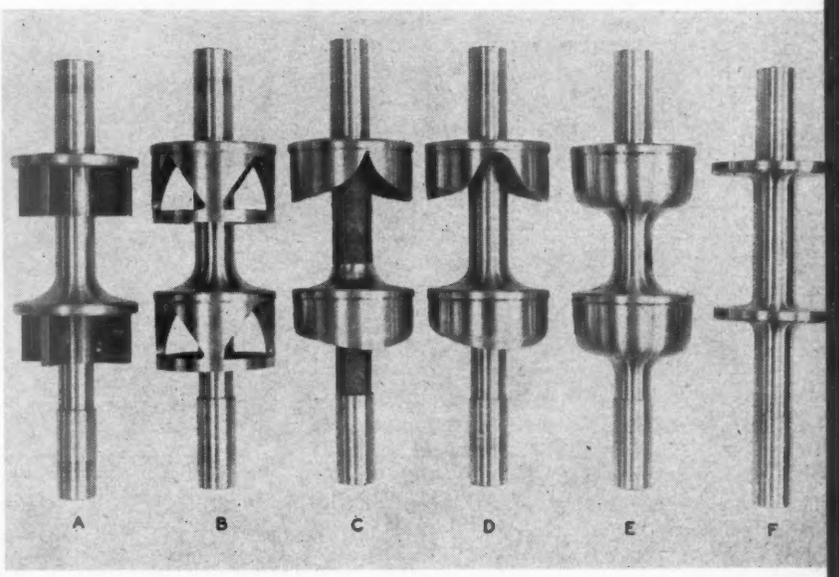
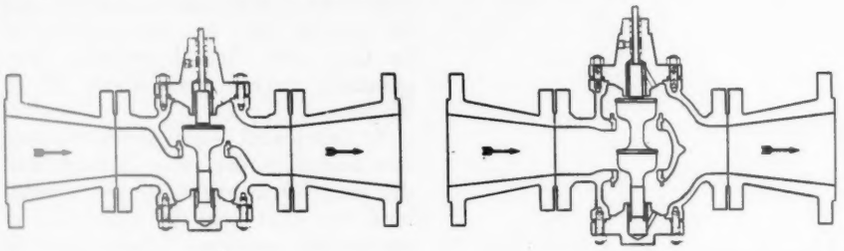


FIG. 8. Cross-section of single and double seated valves.



approached the seat. Plug "E" is a special cup-shaped disc to analyze the force behavior when only the thin edge of the cup is subjected to the fluid velocity.

Fig. 7 shows the 4 in. double seated valve plugs tested under the same conditions. The plugs shown were primarily made up to test rotational forces and flow characteristics. Vertical stem forces were also measured, and this report will be confined to force measurements on the percentage V-port plug (D), percentage parabolic plug (E), and the quick-opening disc (F).

The single seated and double seated body assemblies are shown in section drawing, Fig. 8. All single seated plugs were first tested with the flow left to right, as indicated by the arrows. In this case, the differential pressure, or fluid velocity, tends to open the valve, and the plug stem is in compression opposing the fluid force. The body was then reversed in the test manifold, and all plugs were again tested with the flow through the body right to left. This flow direction produces forces tending to close the valve and the plug stem is in tension.

All double seated plugs were tested with the flow through the body in the normal manner, left to right. The parabolic plug was also tested with the flow reversed.

Parabolic Plug Tests

Fig. 9 plots the net stem force in pounds with respect to lift for a 4-in. single seat percentage parabolic plug with 100 psi drop across the valve body. Sketch "A" illustrates the flow entering under the seat, indicates the plug stem in compression, and identifies the force-lift curve. The net force at the nearly closed or zero lift position can be estimated from the seat area of 11 sq in. and the pressure drop of 100 psi, giving a net upward force of 1100 lb.

Actual measured stem compression at .010 in. lift is slightly in excess of this value. This is within experimental accuracy due to possible error in force measurement, the difficulty of determining the exact seat area with beveled seat, or the exact differential pressure.

Above .20 in. lift the unbalanced force falls off rapidly, and at .90 in. lift the rate of change of force reaches a maximum. If it were possible to continue to increase the plug lift, the force would continue to diminish, and would necessarily approach zero. In practical design there is always some residual force at rated lift, as the maximum exposed port areas are re-

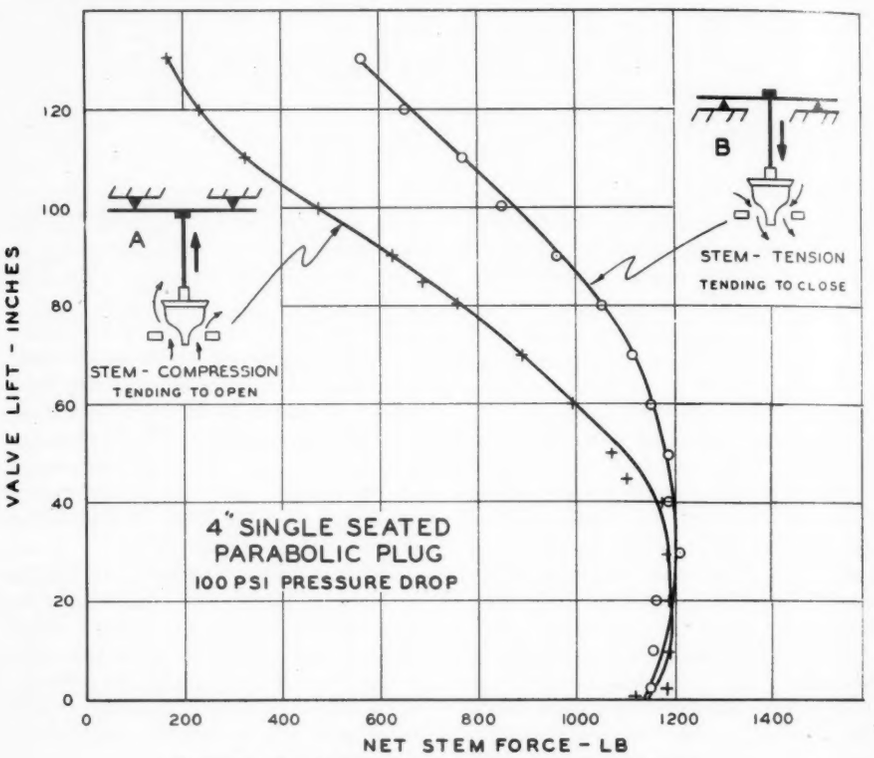


FIG. 9. Single seated parabolic—Lift vs. force.

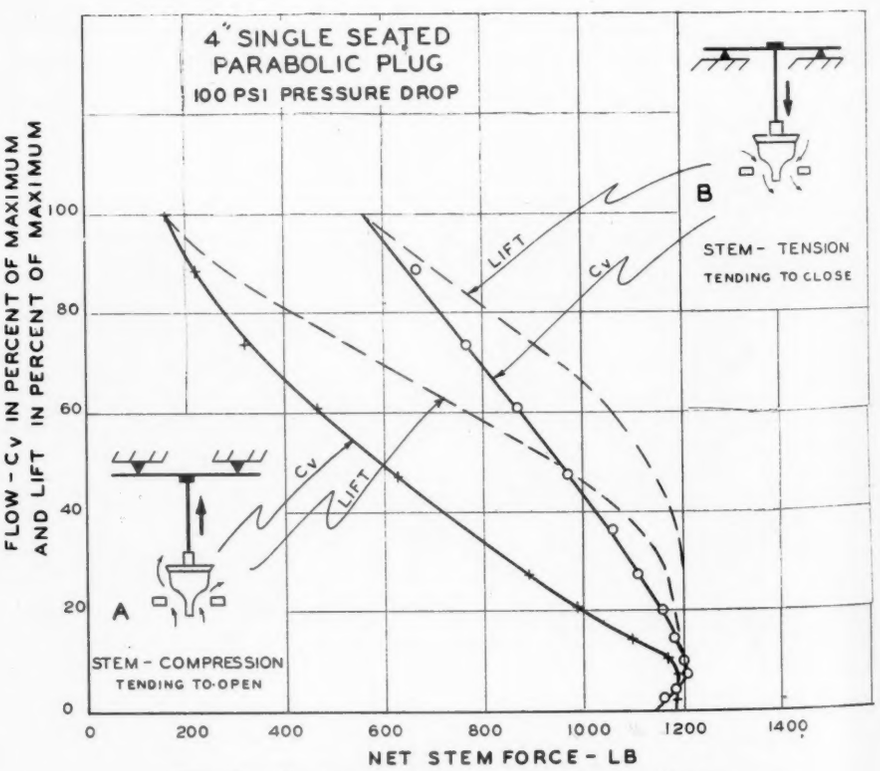


FIG. 10. Single seated parabolic—Flow vs. force.

ANOTHER PERCO* CYCLOVERSION UNIT

Shallow Water Refining Company recently put on stream a new 1200 barrel per day Perco Cycloversion unit at its refinery in western Kansas. This major step in its modernization program was designed by Koch Engineering Company, Wichita. This Cycloversion installation may be operated to desulfurize and reform cracked and straight run gasolines. Excellent octane improvements are attained. Write us for full information on profits in Cycloversion for your Company. Perco Division, Phillips Petroleum Company, Bartlesville, Oklahoma.

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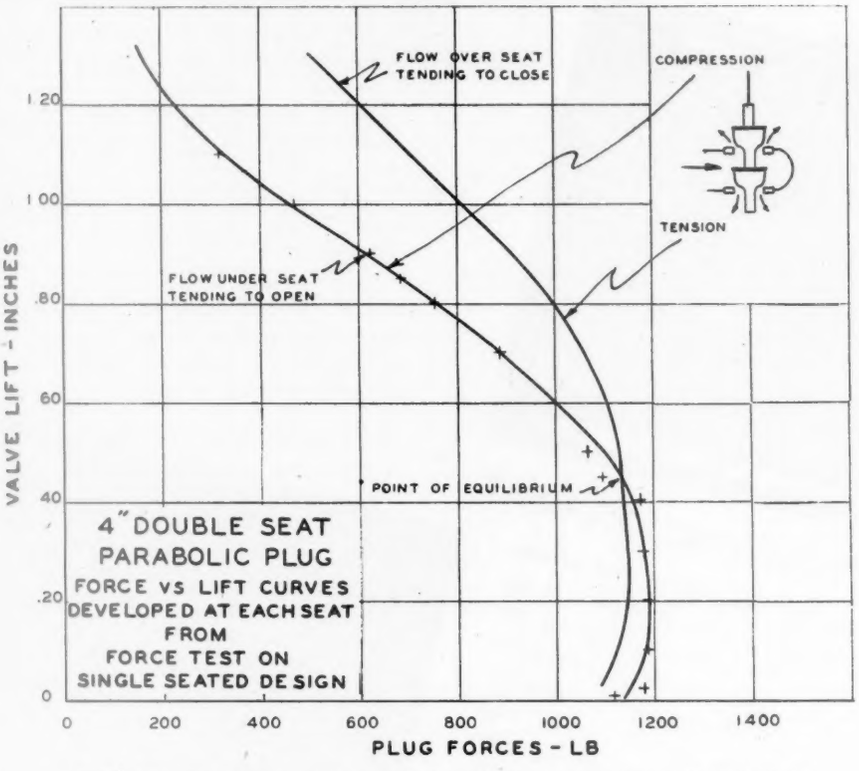

FIG. 11. Double seated parabolic—Lift vs. plug force (S.S. data).

stricted to maintain a reasonable drop across the ports with respect to the body drop. Here the maximum force is 1190 lb and the minimum is 180 lb giving a total change in force of 1010 lb.

There is no reversal in the direction of the force. Although the magnitude of the force changes with the lift, the force is always in the same direction, tending to open.

Sketch "B", Fig. 9, identifies the force-lift graph when the flow enters over the seat, tending to close. The calculated stem tension in pounds with the plug just off the seat equals the area of the seat, minus the area of the stem, multiplied by the pressure differential. Up to about .3 in. lift, the force is nearly the same as in "A", as the stem area represents about 1 per cent of the seat area. Then the force starts to fall-off, but more slowly than in "A", and at 1.25 in. rated lift the force has dropped to 580 lb, a net change in force of 620 lb. Again, note that there is no reversal in direction.

Fig. 10 is a composite graph, showing the lift-force relationships of Fig. 9 and the flow-force relationship for the same test. The ordinate scale is in percent of maximum lift, and also per cent of maximum C_v (gpm at 1 psi pressure drop). The flow characteristic of the test plug is essentially equal percentage giving a fairly flat profile to the plug contours in the first portion of the lift. When plotted in terms of flow, this flat portion of the force-lift curve almost disappears, and the force is more nearly proportional to the flow at constant drop.

The important point is that any appreciable flow through the body in opposite directions produces a substantial difference in the net stem force. At maximum flow, in this example, the difference in stem force amounts to 400 lb.

Now, as the double seated plug is really two single seated plugs with the flow across the ports in opposite directions, this force difference should show up when this type of plug is tested.

The graph (Fig. 11) was developed to predict the force behavior of a double seated parabolic plug from test data on the single seated plug. In the double seated valve the lower plug is usually reduced in diameter so that it just passes through the upper seat ring. Because of this small area difference, a double seated valve is not completely balanced. The lift-force curve of the lower plug (flow over the seat) has been displaced to a lower force value directly proportional to the reduction in seat area. Notice that these forces are plug, not stem forces. The net stem force is the difference between the curves. The horizontal distance between the curves can be read on the plug force scale to determine the net force on the stem tending to open or to close. At .4 in. lift the two curves intersect and the net force is zero. This is the equilibrium position.

The net force difference between the two curves has been plotted in Fig. 12. This curve developed from the single seated plug test data, closely duplicates the general character of the tests on the double seated plug. The maximum unbalance is about 380

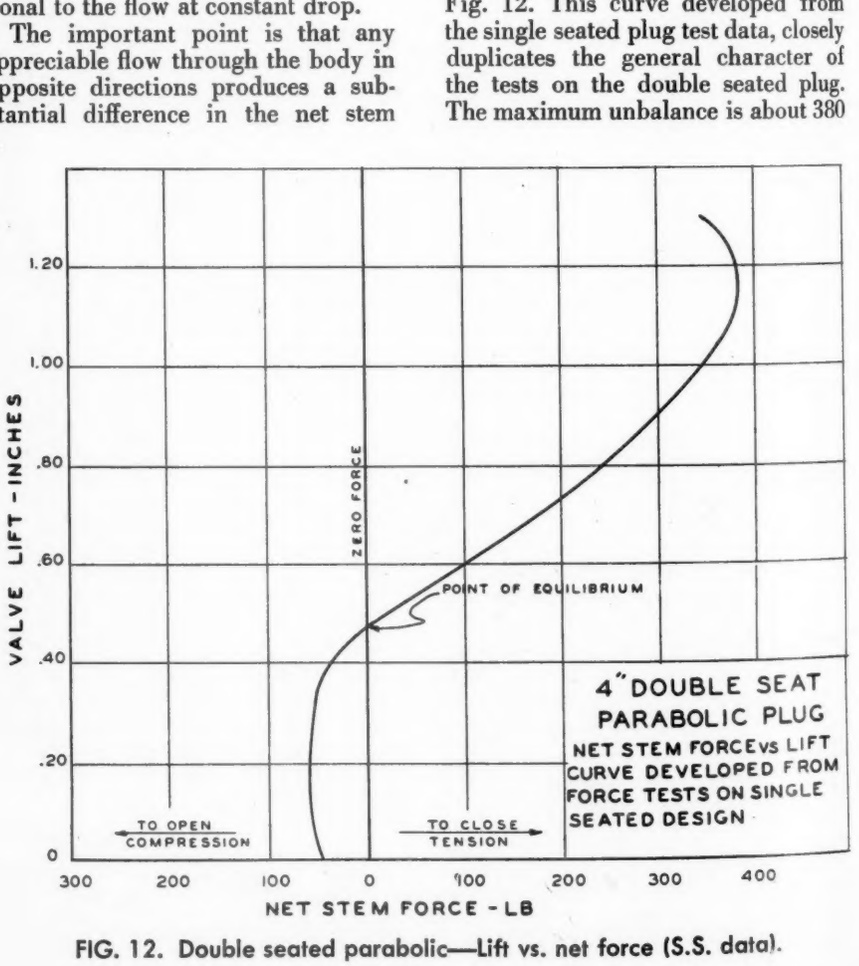

FIG. 12. Double seated parabolic—Lift vs. net force (S.S. data).

lb, whereas tests on the double seated valve with comparable seat area gave a maximum unbalance of 480 lb. This check is as close as should be expected due to differences in the flow pattern, the body porting, and the assumptions used in developing this graph.

Fig. 13 shows the lift-net stem force relationships of a 4-in. double seated percentage parabolic plug at 100 psi pressure drop. Sketch "A" identifies the force-lift curve with the flow entering in the normal manner. In the closed position the net force is a force tending to open which equals the difference in areas between the two seats times the differential pressure. As the plug is lifted velocity effects on the plug result in forces tending to close the valve. At .38 in. lift the two opposing forces are equal. This point has been identified as the equilibrium point. This phenomenon can be easily observed by passing flow through a double seated parabolic valve and allowing the plug to move freely into this position. Force must then be applied to the plug stem to either close or open the valve and when the force is removed the plug will return to the equilibrium position. Above .38 in. lift the force is always in the closing direction. This force increases rapidly and at full lift is approximately 460 lb. From extensive test data and from various field service reports on compressible and non-compressible fluids, the general character of this curve of stem force on the parabolic plug has been clearly established. The magnitude of the force developed under conditions of high pressure drop is a serious limitation on the use of this style of plug with conventional pneumatic motor operators.

When the body is reversed in the line (Sketch "B") the net force at the seated position is a force tending to close the valve. At the seated position and at all lifts the net stem force is now in the same direction. Just above the 80 per cent of maximum lift the net stem force is the same whether the flow is brought in between or over the bridge wall.

It is reasonable to assume that the forces tending to close a parabolic valve are produced by fluid velocity creating variable low pressure areas around the plug. A qualitative analysis of these forces is given in Fig. 14. This is a scale drawing of a percentage parabolic plug at rated lift. As the fluid leaves the restriction between the plug and the seat it contracts to form a jet and produces a low pressure area. This low pressure area produces a force pulling the plug roughly at right angles to the plug contour

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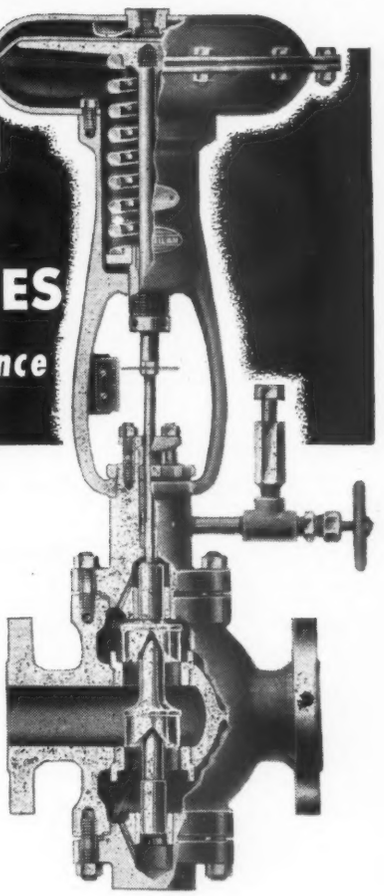

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- Large effective area, moulded diaphragms provide positive response.

Compactness
- Facilitates installation.
- Adds to overall sturdiness.

Reproducibility of Parts
- Modern machinery, tools and fixtures; precision manufacturing methods; rigid inspection during processing and assembly — all insure exact reproducibility of parts — uniform performance.

Interchangeable Parts
- Comparable parts interchangeable between all Percentage Parabolic and Percentage V-Port Valves.
- Trim sizes interchangeable among Percentage Piston Valves.
- Springs for 6-30 psi range may be substituted for 3-15 psi range.

Easy to Service
- Serial plate gives full information.
- Yoke removed without disturbing bolted stuffing box.
- Indicator plate marked in ⅛ inch graduations gives true travel indication, correct rated stroke; makes accurate stem readjustment (after disassembly) automatic.
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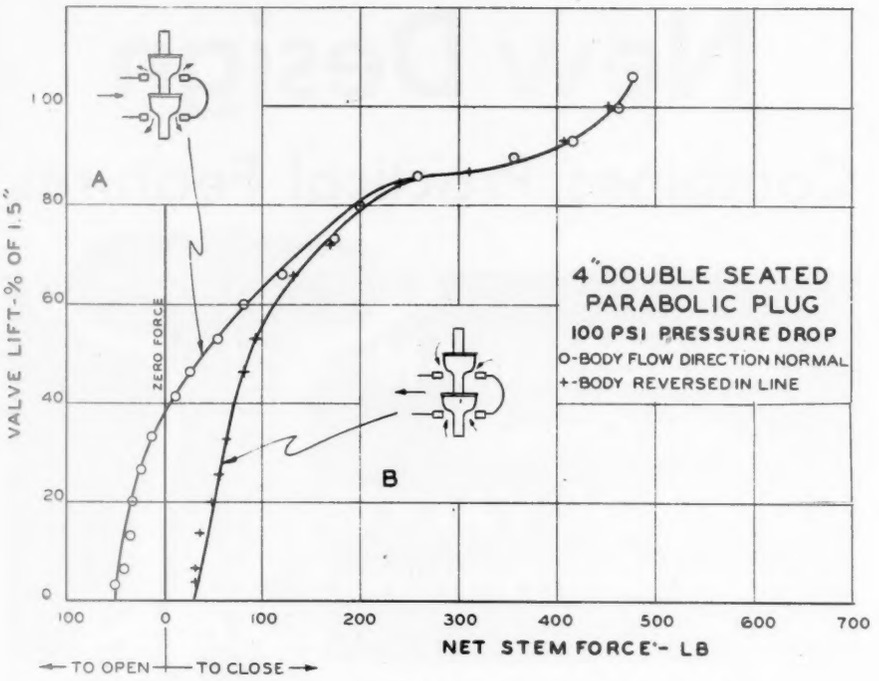

FIG. 13. Double seated parabolic—Lift vs. force (Test data).

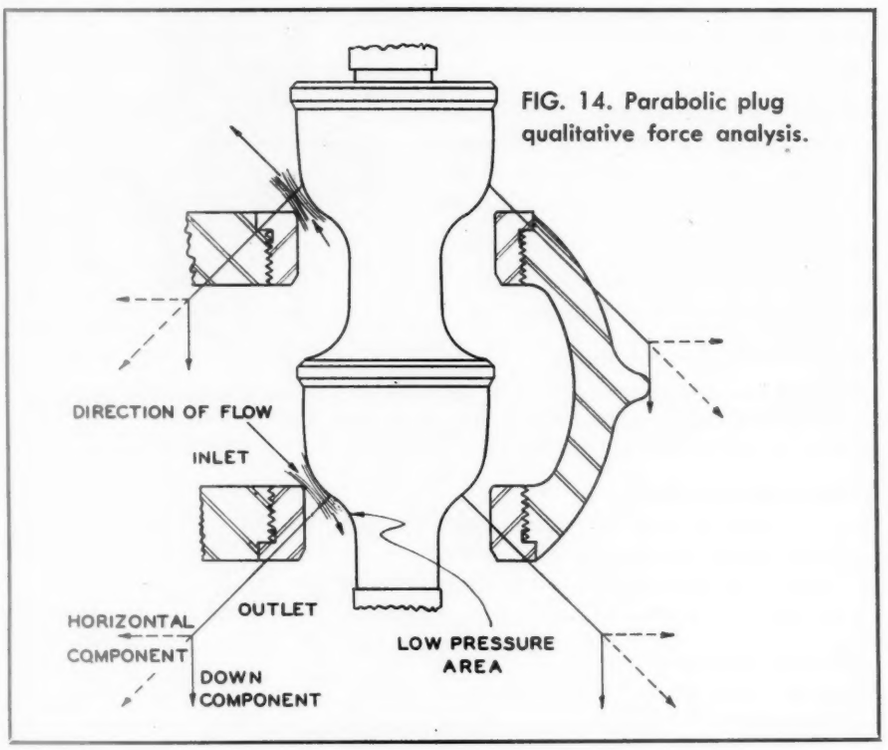

FIG. 14. Parabolic plug qualitative force analysis.

point being considered. This force is shown by a dotted line at an angle from the centerline of the plug.

To form a picture of the net effect of this force, the vector components have been resolved along the co-ordinate axes. These component forces exist around the entire circumference of the plug. Thus, for every horizontal force there is an equal horizontal force in the opposite direction. This cancellation of forces results in complete horizontal equilibrium. The net resultant is a force tending to close the valve and equals the summation of all downwards vector components around the circumference. Notice how the fluid velocity produces forces on both the upper and lower plugs tending to close the valve ports.

Variations in the plug contours will modify the force-lift curve and the equilibrium position, but the general character and value of the forces are not materially altered. * * *

(Part 2 will be published soon)

Gasoline Plant at Snyder Nears Completion

The pressure is on in the construction of the Kelley-Snyder field, Texas, gasoline plant and favorable weather over the next 30 days will speed the completion of this important adjunct to oil production and conservation practices in this great field of West Texas.

The cooperative project in which approximately 30 corporations and 60 individuals are jointly constructing facilities to gather and process casinghead gas for the production of propane, butane, isobutane, natural gasoline, and residue gas, is being built under the direction of Sunray's gas-gasoline department engineers, and the plant when completed will be operated by Sunray's gas-gasoline division headed by H. W. Manley.

As of early January, following completion of the high pressure gas gathering system adjunct of the plant, approximately 18-million cubic feet per day of natural gas is being delivered to the El Paso Natural and Lone Star Gas Companies.

The pipe line low pressure gathering system contractor started ditching and laying operations on November 7. For this operation more than 590,000 ft of right of way is being cleared by the contractor and 190,000 ft of 2-in. to 30-in. pipe has already been coated, laid, and backfilled.

The fact that the high pressure gas gathering system is already in operation will result in the conservation of over 5 billion cubic feet of gas on the basis that the complete plant facilities to process the gas on site will not be in operation until May, 1951.

This system consists of approximately 90 miles of pipe, gathers gas separated from the oil at high pressures so it can be delivered directly to the gas purchaser without requiring any compression facilities.

The plant on present completion basis will have a capacity of 70,000,000 cu ft per day of casinghead gas; the anticipated production of liquid products at this gas throughput is as follows: Propane, 230,000 gal per day; isobutane, 30,000 gal per day; butane, 102,000 gal per day; natural gasoline, 185,000 gal per day; total, 547 gal per day.

E. J. Mills, who was formerly superintendent of Sunray's Benton, Louisiana, gasoline plant, is the plant superintendent in direct charge of all field supervision during both the construction and operating periods. At the present time a staff of approximately 12 Sunray employees make up the Snyder gasoline plant organization aside from the contractors' crews.

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The Possibilities of Mercury Poisoning in Instrument Shops

Giving Methods to Prevent Danger to Personnel From the Definite Hazard of Exposed Mercury

ROBERT F. ANGELL

As mercury vaporizes at temperatures as low as 8.5 F, some mercury vapor will be present in all enclosed or partly enclosed structures in which mercury is exposed to the air at any temperature above this.

The two common modes of entry by mercury into the human body are by absorption through the skin and by breathing into the lungs. Little is known about the absorption of mercury or its compounds through the skin, but it is a well recognized fact by all authorities that the absorption of mercury vapors through the lungs is the most common cause of mercury poisoning.

Although comparatively large quantities of mercury can be taken into the system at one time without fatal results, the exposure to small quantities for a long period of time leads to chronic mercury poisoning.

The quantity of mercury vapor in the air that is sufficient to cause mercury poisoning can not definitely be stated as it depends on the susceptibility and sensitivity of the individual, but continued exposure to very low concentrations (0.6 milligram of mercury vapor per 10 cu ft of air) have brought about symptoms of mercury poisoning.

The symptoms and effects of chronic mercury poisoning arranged in the order of their importance as specific indications are:

Physical disturbances.

1. Fine involuntary tremor.
2. Irritability (Erethism).
3. Timidity (Erethism mercularis).

Buccal cavity symptoms.

1. Coppery discoloration of mucous membranes.
2. Dark lines on gums.
3. Excessive salivary flow.
4. Excessive dental repairs, particularly on teeth containing amalgam fillings.

Other symptoms.

1. Pallor.
2. Loss of appetite and weight.
2. Diarrhea.

The insidious nature of the poison sometimes enables it to progress almost free of symptoms to a certain point, then suddenly the disease is precipitated.

The use of liquid mercury in laboratories and instrument shops does not always result in the establishment of a definite health hazard because of mercury vapors. Its presence and use in laboratories and shops does represent a constant potential hazard, however, that may result in cases of chronic mercurialism.

In instrument shops large quantities of mercury are handled, and every preventative precaution should be taken to avoid the hazard of this poison.

Test results in two petroleum laboratories show definitely that the concentrations of mercury vapor were high enough to cause chronic mercurialism.

Generally speaking, the proper way to avoid poisoning is to prevent the inhalation of mercury vapor and dusts. Mercury vapor has neither taste nor odor to give warning of its presence and, as it is always present where mercury is handled or used, the following precautions should be followed.

1. The most important factor is ventilation. If it is necessary to work in the presence of mercury or its compounds, an adequate rate of air change should be provided.

2. Care should be taken to avoid spillage of mercury and, if spillage should occur, it should be cleaned up immediately.

3. In all rooms where there is a possibility of mercury spillage, floors with a smooth and hard surface are a necessity. Floors should be sloped properly so any mercury spillage may be flushed or drained easily. Wooden floors where cracks are present, or floors with any additional covering such as loose linoleum under which mercury might accumulate, are especially to be avoided. This is also true of rough or porous concrete, as porous concrete will absorb mercury in the same manner as a sponge will absorb water.

4. Mercury should be stored in a closed container, and exposed mercury should be covered with a layer of oil or water wherever possible.

5. The distillation of mercury for refining or cleaning should be done in the open, or under well-ventilated hoods. There should be positively no vapor leaks in the system. The distillation of mercury should be done, preferably, under a vacuum still system.

6. Rubber gloves should be worn when it is necessary to contact mercury or mercury solutions for a period of time. Use extreme care in handling dirty mercury, as dirty mercury is more readily absorbed through the skin than clean mercury on a dry clean skin.

7. Keep food away from mercury dusts, or dust that has been exposed to mercury vapors. Always wash hands and face thoroughly after being exposed to mercury vapors or dusts.

8. When exposed to large quantities of mercury or to vapors of mercury solutions over an extended period of time, gas masks with canisters containing a specially prepared charcoal should be worn.

9. Whenever there are possibilities of exposure to toxic concentrations, the mercury content of the air should be determined at frequent intervals, and periodic medical examinations and urine analyses should be provided for those persons so exposed.

In conclusion: It has been definitely proved by tests, that the use of mercury in laboratories and instrument shops can be a potential health hazard. This hazard does not come only from the distillation of mercury where it is known that mercury vapors are present, but it can come from small particles of spilled mercury or from mercury, in any form, which is exposed to the atmosphere.

This hazard can be greatly minimized by good housekeeping, adequate year around ventilation, and personal cleanliness. These facts should be called to the attention of all persons handling mercury, as often and as emphatically as are other safety matters.

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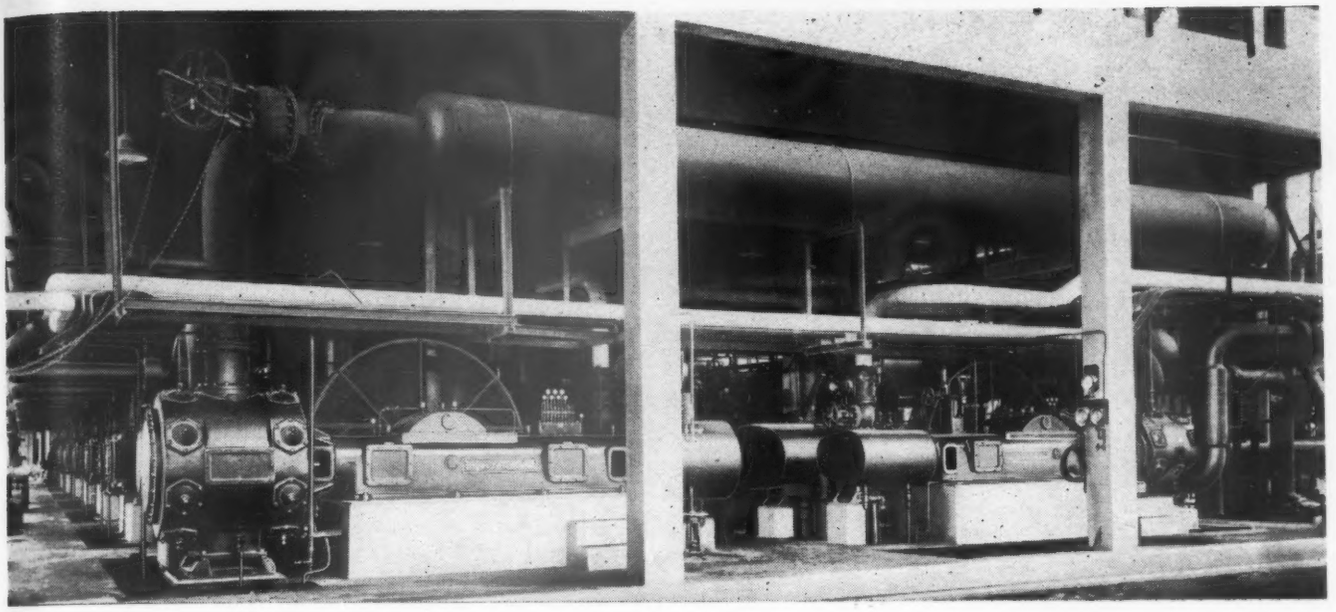


Lubrication of Refinery Equipment

Requirements for steam pumps, air compressors, chain drives, gears, and electric motors concludes discussion; all data are tabulated.

C. M. LARSON

Part 2 (Conclusion)

Additives Used in Lubricating Oils

THERE are two major classes of additives used in lubricating oils. One class is used to control oxidation, reduce corrosion, and the other for its cleaning action as a detergent.

Another class of additives is used to improve some physical property of the oil itself, including film strength, foaming, pour point, viscosity index, and for rust protection.

In this connection, it should be emphasized that the use of additives, or inhibitors does not transform a poor quality base oil into a high quality product although some improvement can be effected in this manner. It is important that the base oil used must be of high quality.

The most commonly used additives may be grouped as follows:

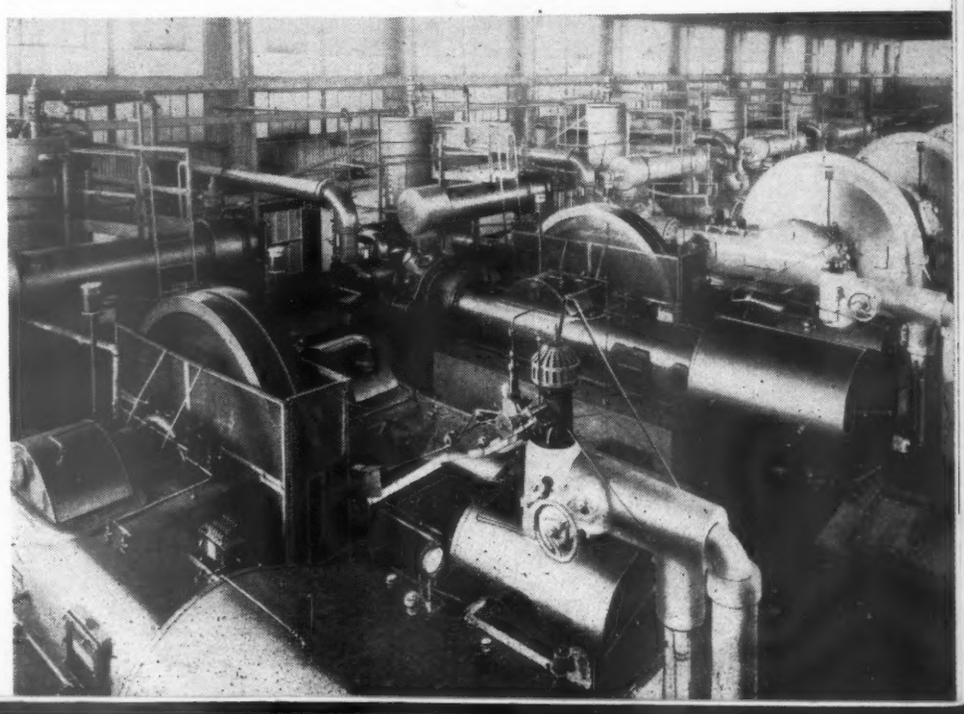
Detergent dispersant, anti-oxidant, anti-bearing corrosion, anti-rust, anti-foam, extreme pressure aids, pour depressant, viscosity index improvers.

Detergent - dispersants are metal salts of organic acids and the metals commonly used are calcium, barium, and potassium.

Each metal and each organic carrier function differently in a lubricating oil so that the development of detergent-dispersants is a highly specialized phase of research being continually investigated by the chemical engineer.

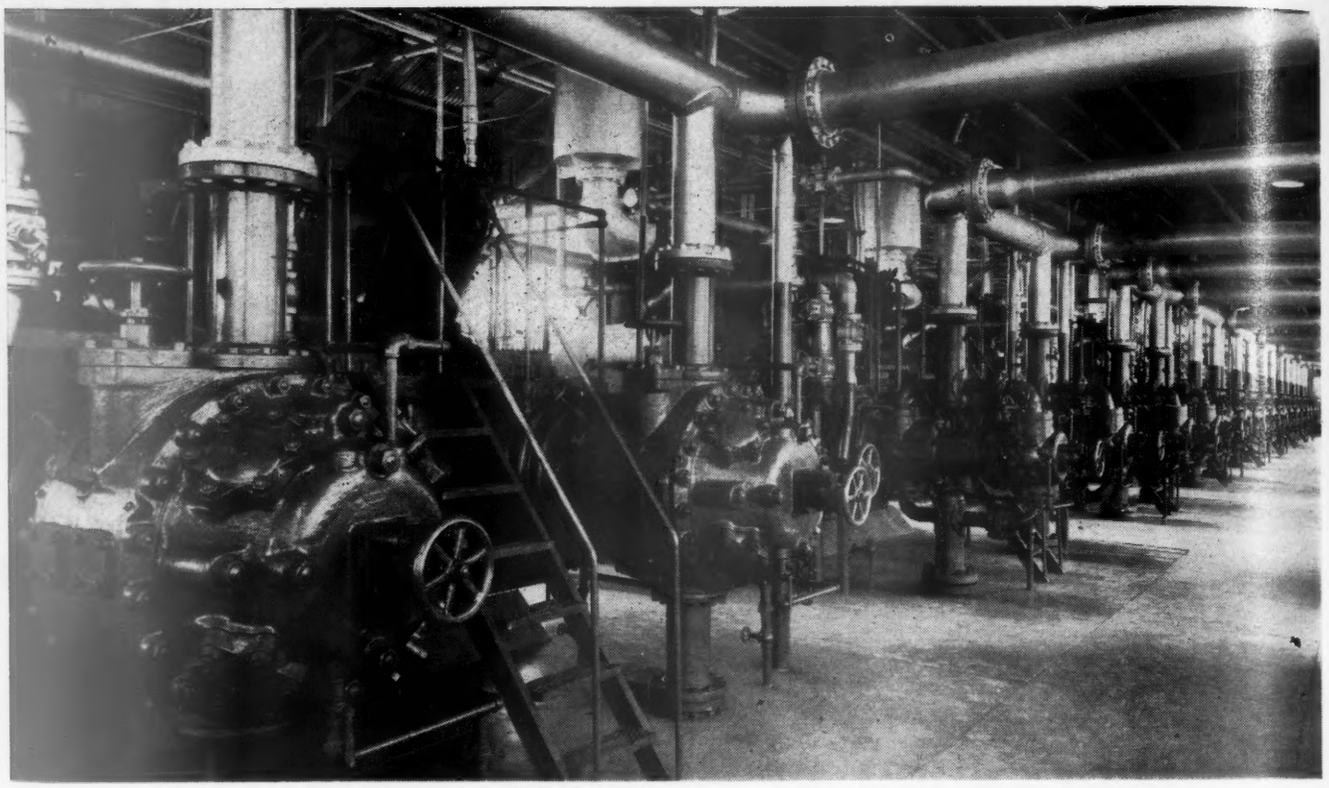
Anti-oxidant and anti-bearing corrosion inhibitors are oil soluble organic compounds containing one or more active inorganic elements made oil soluble by a hydrocarbon or hy-

EXCLUSIVE



Steam cylinders require compounded steam cylinder oil like lubricant No. 13. Air cylinders require non-additive oil like lubricant No. 1 in chart. (Above and at right.)

Courtesy, Ingersall Rand



drocarbon derivative. The active inorganic elements most commonly used are sulfur and phosphorous, or these two in combination. The compounds used to form the organic portion of the inhibitor molecules are phenols, alcohols, and various unsaturated hydrocarbons. Oxidation inhibitors are applied to lubricating oils to decrease the rate of oil deterioration and prevent varnish and corrosion of alloy bearings.

Rusting is essentially a chemical action upon iron or steel surfaces, as distinguished from corrosion, which is referred to here as a chemical action upon non-ferrous metal. In order to prevent rusting, a special additive or metal-wetting agent is incorporated in the oil. These metal-wetting additives are special long-chain hydrocarbons having the ability to change the electrical balance at the molecular level. One side of these molecules has an affinity for metal and the opposite side will be repelled. In this way a film of lubricating oil is kept upon the metal preventing oxygen carrying wet air or moisture from reaching the surface.

Foam inhibitors are generally silicone derivatives and are extremely effective in preventing formation of foam through lowering the interfacial surface tension property of the oil. These inhibitors are used in extremely minute quantities on the order of 5 to 10 parts of inhibitor per million parts of oil.

Extreme pressure agents are added to lubricating oils for the purpose of maintaining an unbroken film of lubricant where pressures are extremely high, such as in hypoid gear lubrication. The problem here is to effectively reduce the tendency to welding of the steel surfaces under the temperature and pressure produced.

Certain phosphorous, sulfur, and chlorine compounds as well as the salts of lead, have been found to posses the ability to increase the load-carrying properties of lubricating oils.

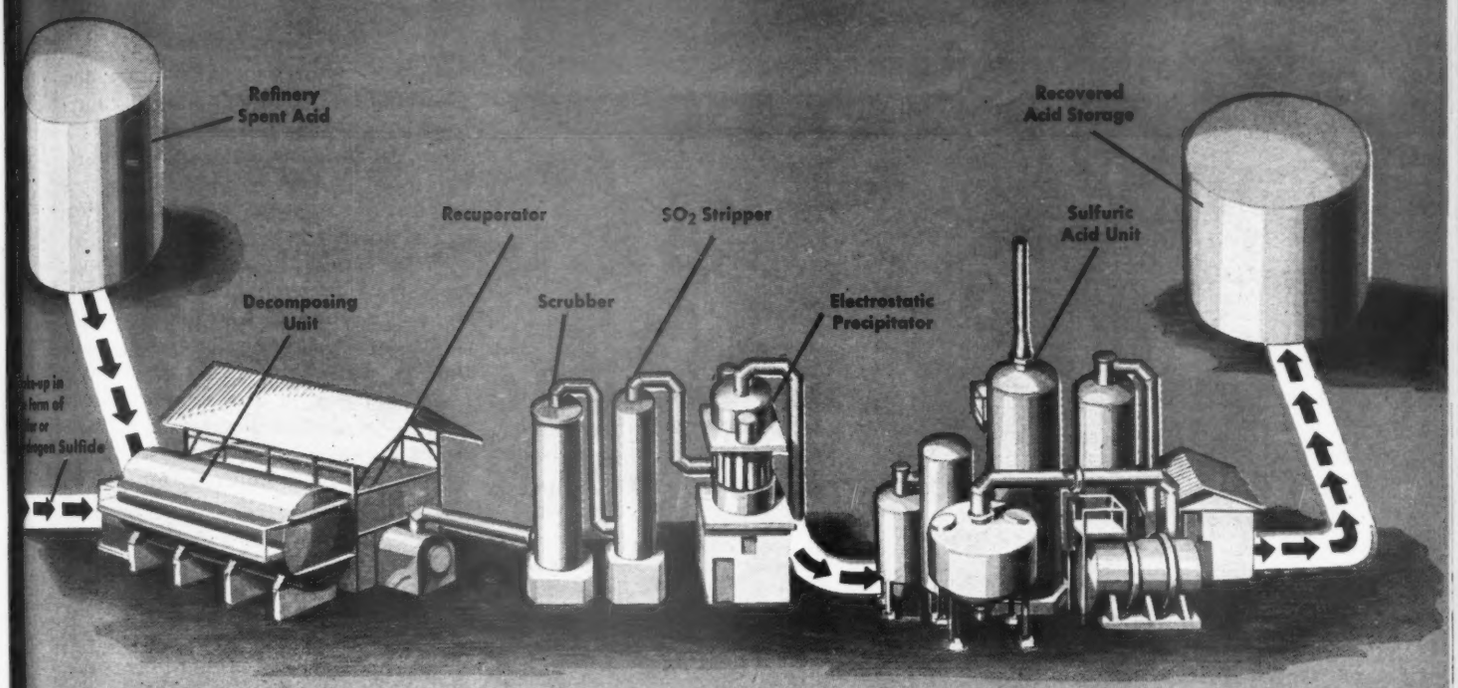
Some petroleum lubricating oils contain wax that congeals at comparatively high temperatures. In or-

Power cylinders and crankcase require heavy duty type lubricating oil of SAE-40 grade. Compressor cylinders are supplied non-additive type oil of SAE-30 grade, lubricant 2 in chart. (Above and at left.)

Courtesy, Cooper Bessemer

CHEMICO OFFERS AN ECONOMICAL PROCESS FOR

Spent Alkylation Acid Regeneration



Due to the increased cost of brimstone and the vital need to conserve basic sulfur deposits, petroleum refiners producing high octane aviation gasoline will find it desirable to recover the sulfuric acid from their spent alkylation acid. For this purpose, Chemico offers a proven and economical process.

In this process, spent alkylation acid—now in greater supply as a result of the increased manufacture of high octane gasoline—is sprayed into a furnace maintained at a high heat with auxiliary burners. Sulfur or hydrogen sulfide may be used as fuel thereby producing SO_2 gas for the production of make-up acid.

A limited amount of other liquid acid sludges, high in hydrocarbon content, may also be added to the alkylation spent acid, thus providing fuel as well as additional acid production. The hydrocarbons are completely consumed and the acid is broken down into its components—sulfur dioxide, oxygen and water. After the water is removed, the gas is processed to fresh acid of 98% strength in a Chemico contact sulfuric acid unit. Send for additional information, stating your requirements.

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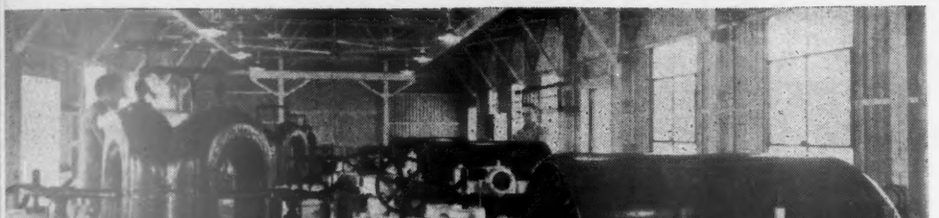
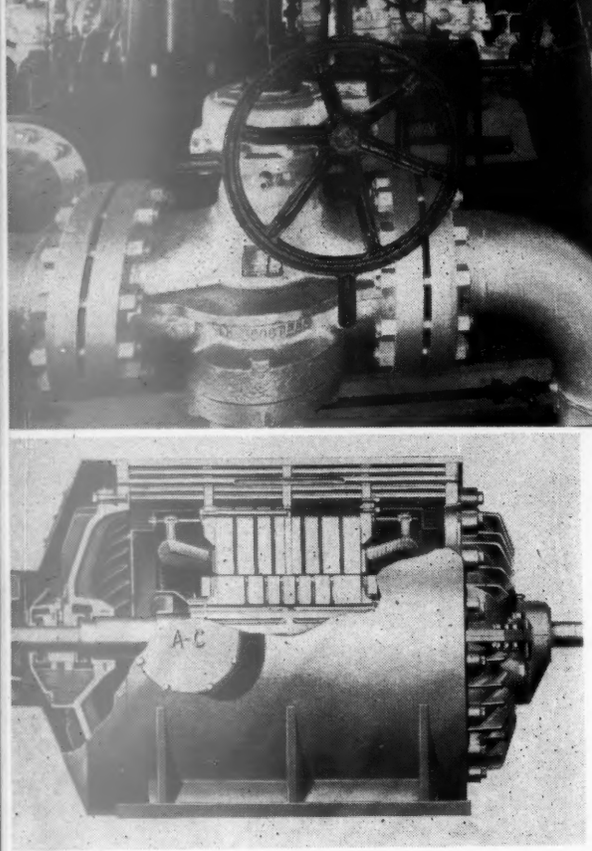




Explosion proof electric motor fitted with ring-oiled bearings. See lubricant No. 1 in chart. (Above and at left.)
Courtesy, Allis Chalmers

der to render the oil suitable for use at low temperatures, it is necessary to remove all traces of the wax from the oil. In order to avoid the excessive costs involved in certain drastic dewaxing operations, pour point depressants are sometimes used.

These special materials, when used, seem to coat the surface of the minute wax crytals, which are then prevented from combining to form gels, even at very low temperatures, and the oil is free to flow.

Viscosity index improvers usually consist of high molecular weight compounds or highly polymerized materials, such as products of unsaturated hydrocarbons, fatty-acids, etc.

Where starting temperatures are unimportant, such as stationary engines, compressors, or motors located inside heated buildings, high viscosity index oils are not an absolute requirement.

Steam Pumps

The steam cylinders, steam valve, piston rods, valve stems, and linkage require lubrication. The pistons operate at comparatively slow speed and take steam at full stroke from the intermediate pressure line (100 to 150 pounds). Cylinder condensation is always high so that the operating conditions are considered as high load, slow speed, and very wet steam.

A large portion of the oil is lost by blowing out with the exhaust steam before it can become deposited upon cylinder walls or piston rod surfaces.

A mechanical lubricator is preferable for feeding the oil but in many instances the well known hydrostatic lubricator is still being used.

A steam refined cylinder oil of medium or heavy compound of tallow oil or a blend of tallow oil and refined degras is used for pumps.

Air Compressors

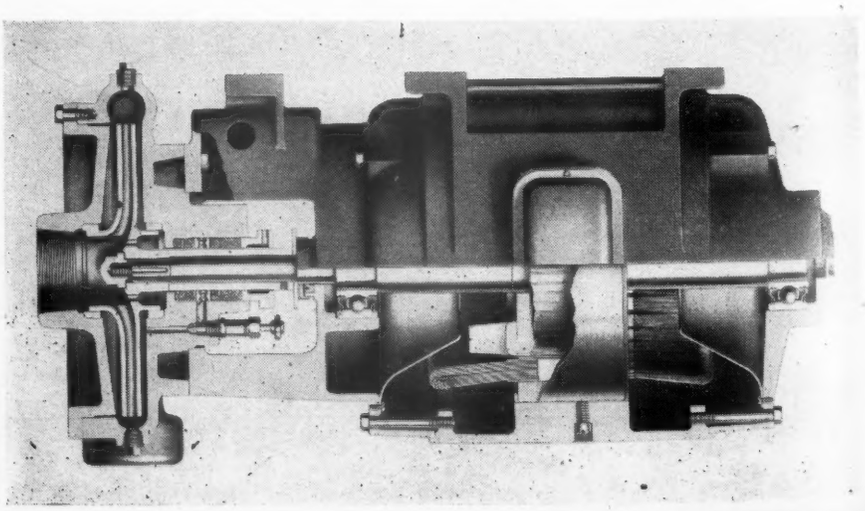
In air compressor lubrication, the most important function of a lubricant is to reduce friction and prevent wear. In order to do this, the lubricant must be kept on the rubbing surfaces so its viscosity and its reaction to water must be considered.

Water enters the system along with free air as vapor and condenses when the temperature of its container (cylinders, air tanks, or pipe lines), reach the dewpoint. Compressed air may become saturated in the after-cooler and in the distribution lines. If the cylinders are cooled below the atmospheric temperature and inter-cooling allows super saturated air to reach the higher stage cylinders, condensate may then collect on the cylinder walls and interfere with lubrication causing rapid wear of cylinders and rings.

Free moisture in any part of the system may cause rust that may reach the rubbing surfaces of either the compressor or the equipment being operated.

The clearance spaces between the piston and cylinder walls and between rings, in their grooves, is capillary in nature and when water is present, it displaces oil by forcing it out of these spaces because of the vast difference in the surface tension of the two liquids.

Under these circumstances, a lubri-



Centrifugal pump direct connected to explosion-proof electric motor provided with ball bearings. Note that pump shaft is cooled and lubricated by circulation of fluid being pumped, which is introduced into lantern at the center of the packing gland. Motor is lubricated by grease No. 15 in lubrication chart.
Courtesy, Allis Chalmers

cant compounded with some emulsifiable oil is necessary.

Air compressors seldom wear due to insufficient lubrication. The fault may be contamination, such as dust or other gritty particles. Air should be cleaned before it enters the compressor. Extra oil feed will not relieve but will actually cause greater damage by excessive carbonization, which deposits on discharge valves. If carbon forms at discharge valves, a less viscous oil, or oil of naphthenic origin, should be used. In severe cases of carbon deposit, an oil containing a detergent type additive should be selected.

Portable air compressors must perform under wide variations in ambient temperature but the most critical period is while starting up after a dormant period. The cold test of the lubricant must now be considered so that the oil supplied will flow freely at the lowest expected temperature. Usually portable air compressors use the heavy-duty oils of the same grade used by the internal combustion engine that drives it.

With the air compressor in otherwise good condition and supplied with clean air, the following are suggested guides in the selection of the proper lubricant.

If excess carbon forms at the discharge valves, select a naphthenic, or detergent type oil.

If rust protection is required, select a rust and oxidation inhibited oil.

If condensation of moisture persists upon the inner surface of cylinder walls causing wear, a lubricant compounded with a fatty oil, such as lard oil, or a detergent type additive oil, is indicated.

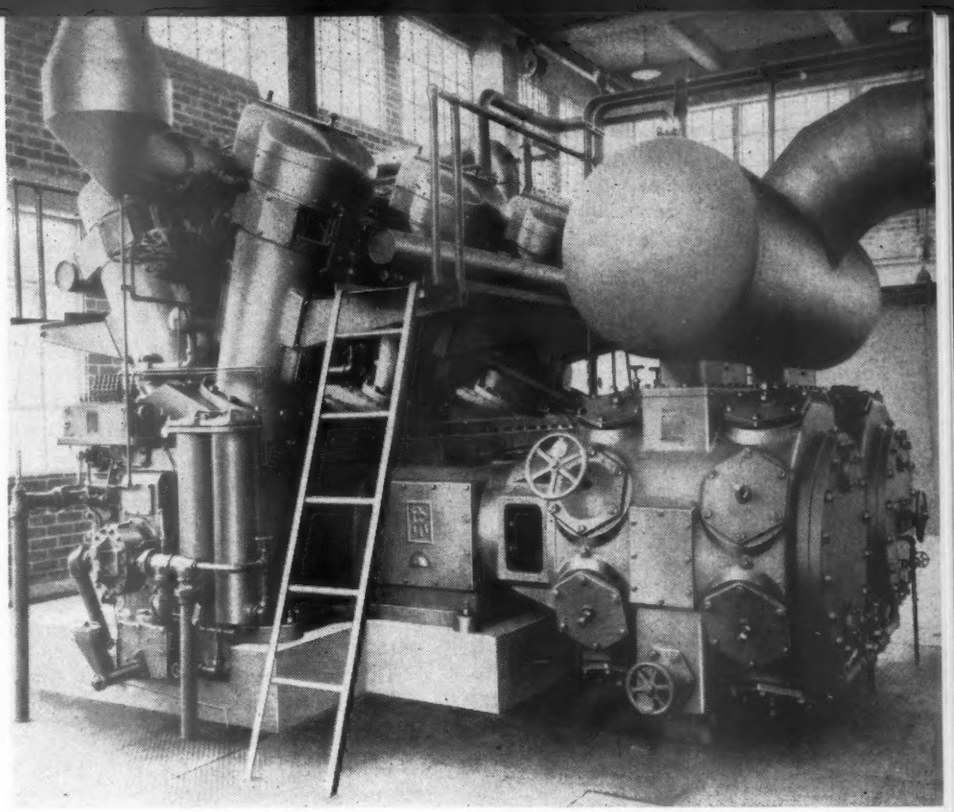
In rare cases where actual scuffing occurs, an additive type oil having high film strength and detergency, should be chosen.

When very low starting temperatures prevail, the higher viscosity index or paraffin type oils should be selected.

When compressors are being used for compressing straight, or wet petroleum gases, the oil viscosity should be at least one grade heavier than when compressing air.

Air compressor lubricating oil specifications for both air and steam cylinders, are given by the Compressed Air and Gas Institute as follows:

	Air cylinders	Steam cylinders
Flash point, F	350 min.	500 min.
Viscosity at 100 F	245 min.	.....
Viscosity at 210 F	45 min.	100 min.
Pour point, F	Plus 35 max.	80 max.
Neutralization number	0.10 max.	.....
Carbon residue, percent	2.0 max.	4.5 max.
Compounding, percent	.....	0 to 12 max.
Centrifugal compressors, thrust bearings and journals:		
Viscosity at 100F	140 to 170 seconds	
Viscosity at 210F	42 to 44 seconds	



Courtesy, Ingersoll Rand Company

Gas-engine-driven, single-stage compressor for refinery gas, intake O gauge pressure, discharge pressure is 65 lb gauge.

Roller Chain Drives

Precision built roller chains should be lubricated with a comparatively low viscosity oil and be protected as much as possible from dirt and blowing dust. The design of the drive and provision for oiling will vary but in general, an oil bath pan or drip oilers are supplied.

When chains are not lubricated adequately, a characteristic oxide, resembling rust, develops on the rubbing surfaces in the joints. Subsequent applications of oil tend to wash this material from the joints but it is a mild abrasive and some will adhere to the rubbing surfaces, with the oil, and wear the pins and rollers. After being allowed to run dry, or after an extended idle period, the chain should be removed, cleaned, and reoiled before put under load. If it has been allowed to run dry long enough so that frictional heat has drawn the temper from pin surfaces, bushings, and links, subsequent lubrication will not prevent wear.

Pins and bushings of well lubricated chains, though worn, are bright and smoothly polished, those of poorly, or unlubricated chains are galled, grooved, and present a brown color.

At high speed the lubricant is thrown from the chains. It may be recovered and used again when a proper protecting guard is provided.

Exposed, or partly exposed, chains should be removed from sprockets occasionally, thoroughly cleaned and reoiled. When exposed to blowing sand and abrasives, chains should be cleaned and reoiled every 150 working hours in extreme cases.

One manufacturer recommends the following:

Chain speed	Method of lubrication
Up to 600 ft per min.	4 to 10 drops per minute, shallow bath, or applied with a brush or spout oil can.
600 to 1500 ft per min.	Rapid drip (20 to 30 drops per minute), shallow bath, disc, or slinger. A circulating pump may be required if transmitted horsepower is large and center distance short.
More than 1500 ft per min.	Continuous oiling with disc, slinger, or circulating pump.

The oil should be of comparatively low viscosity so that it will penetrate to the pin surfaces.

The oil should be of comparatively low viscosity so that it will penetrate to the pin surfaces.

	Ambient temperature		
	Above 10 F	Above 32 F	Above 100 F
General purpose	SAE 10	SAE 20	SAE 30

Gears

Several modifications of both enclosed and exposed gear drives are used with oil refinery equipment. The enclosed gear sets include precision cut spur and herringbone gears found in gear head electric motors and reduction gears, together with worm-gear sets applied to conveyors and filters, and centrifuge oil separators. Open gears include comparatively slow speed miter gears on grease kettles and conveyors, traveling crane, punch presses, sheet metal rolls, etc.

All gear drives require lubrication but the actual product used varies with the type of gear, speed, type of service, whether steady or intermittent, and ambient temperature. Properly lubricated gears should run quietly and show little or no wear. When wear increases the clearance the teeth cannot engage accurately, performance is unsatisfactory because of gear noise and frictional power losses increase.

When properly designed, gears should operate satisfactorily throughout the life of the machine. In addition to normal wear, gears are subject to failure because of pitting, abrasion, scratching, spalling, or galling.

Surface irregularities on the teeth due to variations in hardness or to tiny rough spots of the surface metal allows the load to be concentrated on high spots instead of being evenly distributed over the entire tooth area. These high spots finally fail and break out of the metal, leaving pits in the face of the teeth. Spur gears are more apt to fail in this way than are helical cut gears.

Dirt and grit deposited on the gears becomes mixed with the oil and the gear teeth are worn by the grinding action of the abrasive. As the teeth are worn down, the metal particles that are torn off also mix with the oil to intensify the grinding or abrasion. Oil will not prevent or cure this condition, which is one of prevention maintenance. Gears should be protected from dirt.

Scratching may be caused by abrasives or highspots, or projections, along the edge of the teeth of one gear, which actualy digs metal from its mating tooth on the other gear.

Spalling or peeling, may be caused by misalignment, or by overloading the gears. The metal flakes off and is carried along by the oil creating high spots on some other pair of teeth. This is a condition of mechanical or design failure, and lubricants can do little to overcome it.

Under severe overloading, the tooth metal actually flows as a plastic. The condition is known as galling, and is unmistakable. Some relief may be obtained through the use of extreme pressure lubricants, but damaged gears must be replaced and a new start made. Hypoid and worm gears are often galled during operation.

Enclosed gears used with oil refinery equipment comprise gear head electric motors, speed reducing sets on can filling machines and allied equipment, rotary pumps, mixers, contactors (filter equipment), chemical proportioning pumps, centrifugal oil separators and many isolated units. All of the gears in these sets are precision cut, and all are bath lubricated. Loading is normal so that no special problems are presented but the lubricant is expected to perform over extended periods of time, so highly refined oils of turbine type should be used.

The SAE viscosity grade recommended will be governed by the operating and ambient temperatures. High speed, lightly loaded, intermittent service conditions may use SAE 20 grade; high speed, normal load, continuous service will require an SAE 30 grade; enclosed gear sets operating at comparatively high temperatures, any speed and loading where the ambient temperature is also high, require an SAE 50 grade oil.

The gear cases should not be filled above the indicated level because the constant churning and agitation of the oil by the revolving gears increases the temperature and pressure within the gear case causing leakage and consequent wastage of oil.

In oil refineries, open gears are used on package conveyors, bucket elevators, metal working machines and in a few isolated locations. These gears run at comparatively low speeds and are not heavily loaded. In many instances the duty is highly intermittent.

The lubricant recommended is highly adhesive to metal and semi-fluid or plastic in nature, so that it will remain in place on the gear teeth, spreading out over the surface as the teeth separate after contact. This product contains refined cylinder stock oil, together with sufficient soaps to produce a lubricant corresponding to N.L.G.I.

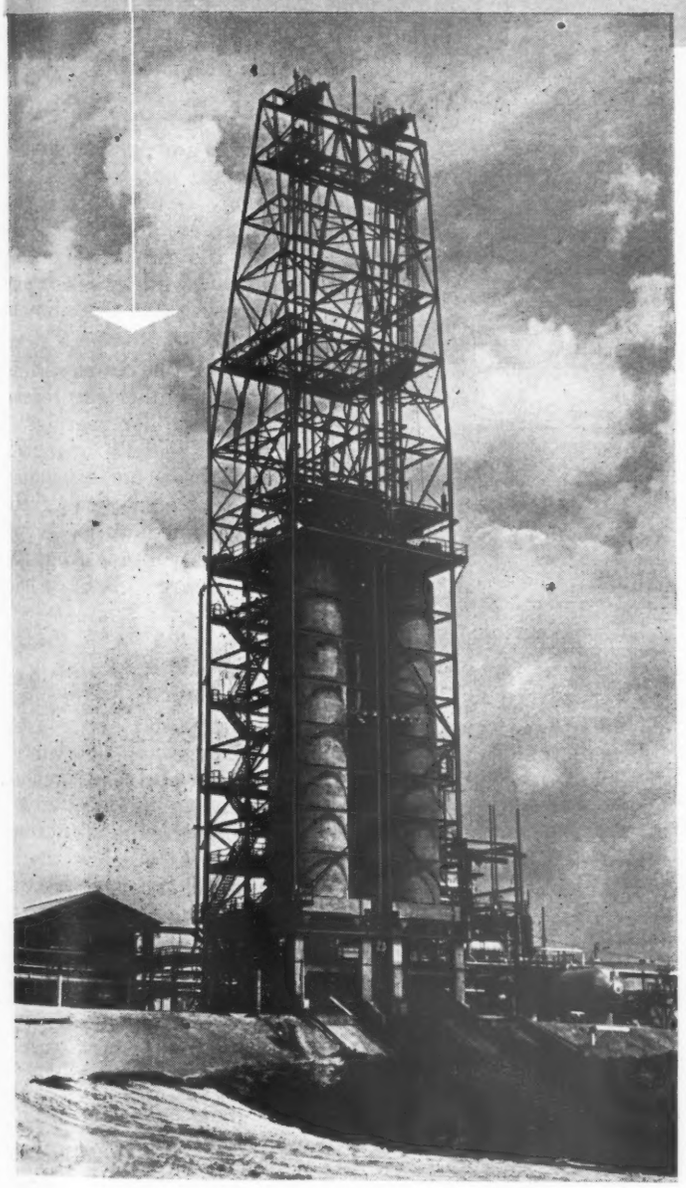
CHARTED LUBRICATION FOR EQUIPMENT OF TYPICAL REFINERY

Product	Unit	Application
1. A highly refined, non-additive, turbine type, general purpose lubricating oil having a suitable viscosity tolerance in the 250 to 350 seconds at 100 F range. For use in forced-feed systems, ring oiled bearings and hand oiling. This oil is SAE 20 grade.	Air compressors	Cylinders, crankcase
	Blowers	Bearings
	Bolt cutter	Bearings
	Boring mill	Bearings
	Can fillers	Variable speed drive
	Centrifugal pumps	Bearings
	Contactor unit	Bearings, seals
	Conveyors	Roller chains
	Drill presses	Gears, bearings
	Electric motors	Ring oiled bearings
	Freight elevator	Bearings
	Gas compressors	Cylinders, crankcase
	Gear head motors	Gear Case 0° to 40 F
	Hydraulic control systems	General lubrication
	Heater feed pumps	Reservoir, governor
	Lathes	General lubrication
	Milling machine	General lubrication
	Pipe threading machine	General lubrication
	Planer (metal and wood)	General lubrication
	Power saw	General lubrication
	Presses (metal)	General lubrication
	Rolls (sheet metal)	General lubrication
	Rotary pumps	Bearings, chain drive
	Saws (band, circular, metal)	General lubrication
	Shaper (metal and wood)	General lubrication
	Steam pumps	Linkage
	Steam hammar	Linkage
	Sump pumps	Lower bearing
	Vacuum pump	Cylinders, crankcase
2. A highly refined, non-additive, turbine type, general purpose lubricating oil having a suitable viscosity tolerance in the 400 to 600 seconds at 100 F. For use in forced-feed systems and ring-oiled bearings. This is SAE 30 grade.	Air preheater	Speed reducer, gear case
	Blowers	High temperature operation
	Coal pulverizer	Gear case
	Digester (contact and acid unit)	Bearings
	Gear head motors	Gear case 40 to 100 F
	Induced draft fans	Bearings
	Mixers (lube addend unit)	Reduction gears
	Oil preheaters	Speed reduction gear cases
3. A highly refined, non-additive aviation type lubricating oil having a viscosity of 110 to 125 seconds at 210 F. For use in forced-feed systems and ring oiled bearings. This oil is an SAE 50 grade.	Air preheater	Rotor support pinion gear
	Can fillers	Speed reducer
	Can unscrambler	Speed reducer
	Chemical proportioning pump	Speed reducer
	Contactor	Transmission gears
	Conveyors	Gears
	Fan (cooling tower)	Transmission gear case
	Filters	Speed reducer, drive gear, worm gear
	Gear head motors	Gear case 100 to 150 F
	Hoist gear	Bearings
	Mixers	Speed reducer gear case
	Polymerization unit	Gear case, rack and pinion
	Shaft couplings	
4. A highly refined, lubricating oil compounded with No. 1 Lard oil for cylinder lubrication in wet air conditions. This oil is in the 700 to 800 seconds at 100 F range, or SAE 40 grade.	Axial compressors (still)	General lubrication
5. A highly refined, additive type, corrosion resistance turbine lubricating oil having a viscosity of 140 to 170 seconds at 100 F, corresponding to SAE 10. This oil should meet General Electric, Westinghouse, and Allis Chalmers specifications for direct-connected units.	Hydraulic transmission (crude still)	Closed system
	Hydraulic systems of (Norton grinder, radial drills and turret lathes)	Closed system
	Steam turbines (Westinghouse and Coppus)	Bearings
6. A highly refined, additive type, corrosion resistance lubricating oil having a viscosity of 250 to 350 seconds at 100 F range, corresponding to SAE 20 grade. It also should meet General Electric, Westinghouse, and Allis-Chalmers specifications for auxiliary geared sets, and for single reduction gear turbines.	Screw pump (propane and phenol unit)	Bearings and gear case
	Steam turbines (Murray and Terry, water cooled bearings)	Bearings 7 circulating systems
	Turbo-blower	Bearings

(*Continued*)

Pan-Am Southern relied on this sign...

and got a Coking Unit ahead of schedule



The new Coking Unit at Pan-Am Southern Corporation's El Dorado, Arkansas, refinery is another example of how the close coordination and control of all details on the part of Lummus paid off for the customer.

In spite of the fact a 42-day steel strike tied the "critical" tag to equipment fabrication schedules on this project, the unit was completed *ahead* of specified date. Holding down initial outlay and hastening on-stream earnings are frequent and welcome by-products of a Lummus contract. In this case, the unit underran guaranteed maximum cost by 8%.

Moreover, this unit went on stream immediately and operated 86 days out of the first 98 days after completion—a smooth-running result of good engineering and skillful construction. Today, the plant is playing an important role by increasing the flexibility of Pan-Am Southern's operation, and by helping to meet increased demand for gasolines and other light distillate products.

Pan-Am Southern management acknowledges *extra* value received for relying on the Lummus sign. It's a good symbol to look for, believe in and rely on when you buy complete, integrated engineering service for *your* next project.

Pan-Am Southern's coking plant charges crude fractionation bottoms previously sold as lower-grade fuel oils. Charge rate is 9,300 B/D of 13.0° API reduced crude. Product yields are 1,950 B/D of C_4-400 E. P. gasoline, 5,240 B/D of 25.0° API gas oil for cat cracker charge stock, 420 T/D of premium coke, plus a quantity of C_3 and lighter fuel gas.

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CHARTED LUBRICATION FOR EQUIPMENT (Continued)

Product	Unit	Application
7. A highly refined, additive type, turbine lubricating oil having a viscosity of 380 to 550 seconds at 100 F, corresponding to an SAE 30 grade. This oil should meet Symbol 2190T and Navy Specification 14-0-15, as well as General Electric and Westinghouse specifications for large geared units.	Clarke gas compressors	Cylinder and external lubrication
8. A conventionally refined or solvent treat, non-additive, general purpose lubricating oil having a viscosity of 250 to 350 seconds at 100 F, together with a very low cold test, corresponding to an SAE 20 grade.	Filters (dewaxing unit)	Mechanical lubricator
9. A very highly refined, non-additive spindle type lubricating oil, having a viscosity of 50 to 60 seconds at 100 F.	Norton grinder	Spindle bearing
10. A very highly refined, non-additive spindle type lubricating oil, having a viscosity of 40 to 45 seconds at 100 F.	Centrifugal pumps (alkylation unit) Centrifugal pumps (heater feed pump)	Stuffing box seal Stuffing box seal
11. A conventionally refined or solvent treat lubricating oil compounded with lead soap. Possessing extreme pressure characteristics, with a viscosity of 85 to 100 seconds at 210 F, corresponding to SAE 50 grade.	Can closer Can filler Rotary pumps (barrelhouse)	Upper gear housing Gearmeter Gear cases
12. A steam refined, filtered lubricating oil, corresponding to SAE 250 grade. Should be inhibited against foaming.	Radial drill (shop)	Powerhead Travers unit
13. A steam refined, compounded cylinder oil, having a viscosity of 130 to 150 seconds at 210 F, and 5 to 7% acidless tallow, for use in wet steam conditions.	Steam driven air compressors Steam hammer (boiler shop) Steam pumps	Steam Cylinders Cylinder and slides Cylinders and rods
14. A semi-fluid lubricating grease composed of SAE 250 gear oil, to gether with other suitable ingredients to produce a highly adhesive properties.	Elevator (barrel house) Traveling crane (boiler house)	Wire cables Winding drum, truck gear, cables
15. A high melting point antioxidant lubricating grease, containing a highly refined lubricating oil of SAE 20 grade, and sodium type soap, corresponding to N.L.G.I. No. 2 consistency, suitable for use in ball and roller bearings.	Agitators (barrel house) Air compressors Automatic Gluer (barrel house) Blowers Box compressors (barrel house) Can closers (barrel house) Can fillers (barrel house) Can unscrambler (barrel house) Carton unflapper (barrel house) Centrifugal pumps Chemical proportioning pump (polymerization unit) Conveyers Chillers Contactor (Alkylation unit) Drum Chime straightener (barrel house) Grease kettles (grease house) Heater feed pumps (stills) Hydraulic transmission (SRF unit, light oil, addend, polymerization) Lathe, turret (shop) Milling machine (shop) Pipe threading machines Rotary pumps Steam pumps Steam turbines (Pyle National) Traveling crane (boiler shop) Wood working machinery (carpenter shops)	Bearings Idler bearings, eccentric Grease fittings Plain grease lubrication Grease fittings Grease fittings All grease cups, open gears Grease fittings Grease fittings Grease lubricated, stuffing Linkage Roller bearings Idler bearings, scraper bearings Upper bearing Bearings Bearings Governor, guide rod bearings Pillow block bearings Grease cups Grease fittings Chain drive, clutch Bearings, stuffing box Rocker shaft bearings Bearings, governor Shaft bearings Grease cups
16. A tacky lubricating grease composed of well refined SAE 60 lubricating oil, together with aluminum soap corresponding to N.L.G.I. No. 1 consistency highly water resistant and very adhesive to metals.	Sump pumps (exposed)	Upper bearings
17. A mild EP or multi-purpose type gear lubricant, corresponding to an SAE 140 grade.	Traveling crane (boiler shop)	Gear case, trolly drive gear intermediate hoist

No. 1 consistency. This lubricant may be applied with a brush.

In very dusty locations, such as the bucket elevator head gears, in the Fuller's earth burner building, it would be better to allow the fully exposed gears to run dry.

Where very slow speeds are required, worm gears may be used. They are bath lubricated, but the extremely slow speed of the wheel does not permit the lubricant to maintain the required wedge between the sliding surfaces. Even under very light loads worn gears tend to heat so the lubricant recommended is a refined cylinder stock oil compounded with tallow.

Lubrication of Electric Motors

Next to steam turbines, electric motors constitute the largest source of motive power in oil refineries. They are direct-connected or arranged to drive machinery through reduction gears. All modern installations comprise the explosion proof type frame and the bearings may be ring oiled or grease lubricated ball bearings.

Although the lubrication of electric motors is more a condition of good maintenance than a perplexing problem, there are certain requirements that must be fully considered.

All sleeve type bearings fitted with rings or wicks are lubricated with oil. Some motors fitted with ball bearings are oil lubricated but the majority use grease.

Electric motor oil should have the proper fluidity at the operating speed and temperature which means that it should be highly refined, non-additive, turbine type oil, having a viscosity in the range of 250 to 350 seconds at 100 F. This corresponds to an SAE 20 viscosity grade.

The oil wells should be kept filled, but if oversupplied, there is a tendency for the oil to creep and waste. Although an oil slinger is provided at the rotor end of the housing, oil will work into windings when an excess is used. This also applies to vertical shaft motors fitted with oil lubricated ball bearings.

Grease lubricated ball bearings will run without attention to lubrication for long periods. These bearings have the disadvantage that the application of excessive quantities of grease can become a major cause of bearing failures. It would seem that the successful lubrication of ball bearings is a knowledge of what not to do.

Grease packed or double-shielded type bearings are lubricated for their useful life by the manufacturer, and it is impossible to add grease to them. Do not use a grease gun for ball bearings unless there is no other means available. If a grease gun is used, the drain plug in the bearing housing should be removed while greasing and all excess grease allowed to drain out before it is replaced.

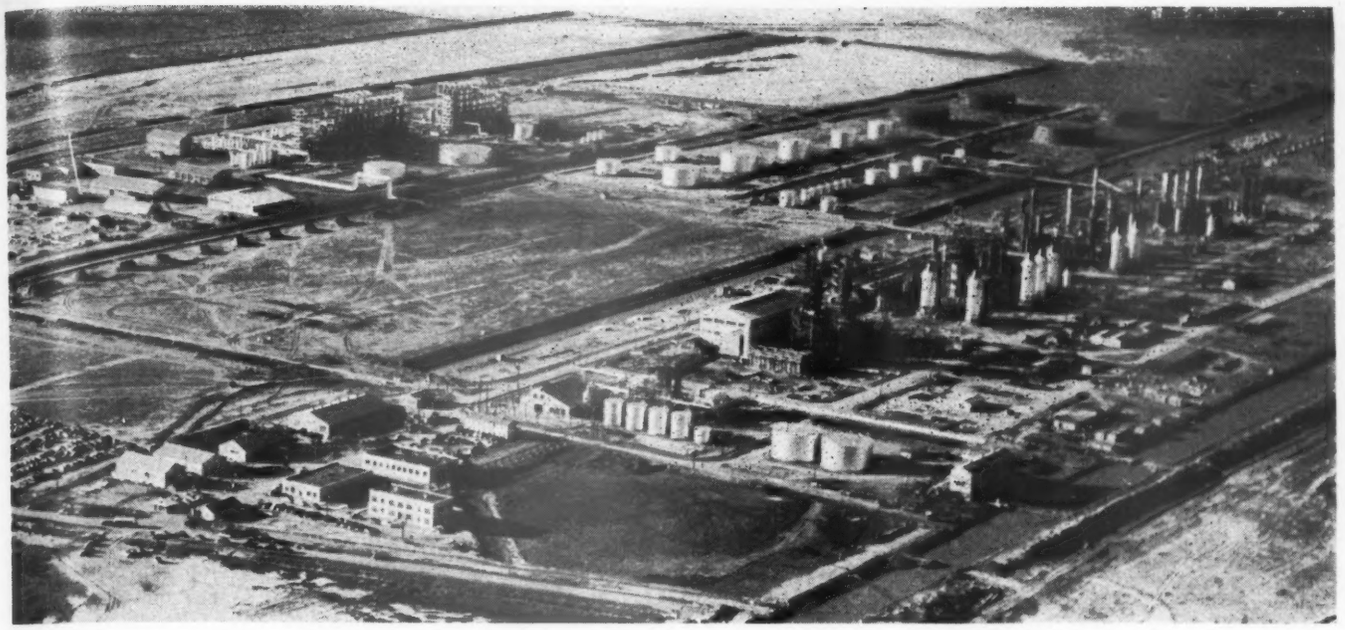
Cup grease should never be used in ball bearings. The lubricant recommended for ball or roller bearings, is an all purpose, specially manufactured, smooth grease, corresponding to N.L.G.I. No. 2 consistency, containing a highly refined lubricating oil of SAE 20 viscosity grade, together with high temperature sodium or lithium type soap.

Charted Lubrication for Equipment of a Typical Refinery

Through proper selection, inventories of lubricants may be reduced to a minimum and possible errors in application greatly limited. For the purpose of simplifying the lubricating problem as much as possible, a general lubrication chart is presented, covering the mechanical equipment found in a typical oil refinery, including turbines, engines, pumps, electric motors, drives, shafting and machine tools. Each separate unit is listed for the particular lubricant recommended, together with its application.

The writer wishes to take this opportunity to thank the various companies, such as, American Blower Corporation, Allis-Chalmers Manufacturing Company, Chicago Pneumatic Tool Company, Cooper-Bessemer Corporation, De Laval Steam Turbine Company, De Laval Separator Company, Elliott Company, General Electric Company, Ingersoll-Rand Company, and Westinghouse Electric Corporation, for their cooperation in supplying material, which proved helpful in writing this article.

* * *



Carthage Hydrocol and Stanolind plants at Brownsville, Texas.

Synthetic Fuels Plant in Shakedown Stage

Two New Units Are Epoch-Making Developments—Natural Gas and Oxygen Will Make Fuel and Chemical Products

ARCH L. FOSTER*

THE synthetic fuels plant of Carthage Hydrocol, Inc., at Brownsville, Texas is now in the "shakedown" stage of initial operation, according to reliable company sources. It is understood also that the by-products recovery or concentration plant of Stanolind Oil and Gas Company, adjacent to the fuels plant, is also working out the numerous problems of initial operation, which beset any new plant no matter how well engineered it may be.

Situated at the extreme southern tip of the United States, in an area producing huge quantities of cheap natural gas, the work of this plant assumes increasing importance as war clouds thicken and thunder. The Stanolind plant, it is understood, receives the dilute by-product solutions of alcohols, aldehydes, acids, glycols, ketones, and other oxygenated hydrocarbon products and concentrates and separates these various materials for delivery to U. S. Industrial Chemicals for use as raw materials or intermediates in the manufacture of chemicals, or for sale "as is."

Reviewing briefly the salient facts that have been publicized many times in the last three years, the Carthage Hydrocol plant will utilize the modern development of the so-called Fischer - Tropsch synthesis for the production of some 7000 bbl per day of various types of hydrocarbons, chiefly of the motor fuel range, along with smaller amounts of distillate fuel oil and heavy fuel oils. One statement indicates that the daily production will be 6000 bbl of gasoline, 900 bbl of diesel fuel, and 200 bbl of (heavy) fuel oil, along with 300,000 lb of chemicals, composed of alcohols, aldehydes, acids, ketones, and other oxygenated hydrocarbons.

The Hydrocol process, which will be used in the plant, is a joint development of Hydrocarbon Research, Inc., and The Texas Company. The plant will consume 90,000,000 cu ft of natural gas per day, and will utilize the oxygen recovered and concentrated from 280,000,000 cu ft of air daily. The gas is obtained through a 63-mile pipe line ranging in size from 12¾ in. to 16 in. in diameter. It conveys the gas from the San Salvador, South Weslaco, and La Blanca fields. The major company officials are Guy George Gabrielson, president and general counsel; Frank M. Dawson, vice president; Allen K. Brehm, treasurer, and A. L. Wolfe, secretary; R. H. (Tiny) Aitken, superintendent, and V. K. Brandenburg, assistant superintendent at Brownsville.

The main steps in the process, publicized a great deal in recent years, were developed in the early 1920's in Germany by Franz Fischer and Hans Tropsch, in the effort to convert coal to liquid and gaseous hydrocarbon fuels. In the first step either coal or natural gas, the latter used at Carthage Hydrocol, is heated with air or oxygen in the presence of a catalyst to effect the so-called water gas reaction, converting the carbon in coal, or in gas, to carbon monoxide; the hydrogen of the gas is changed mainly to molecular hydrogen, part of it may be oxidized to water, H_2O. When using coal, steam is employed to furnish the hydrogen to make up the so-called "synthesis gas" of CO and H_2.

The second step consists in reacting this mixture of gases in the presence

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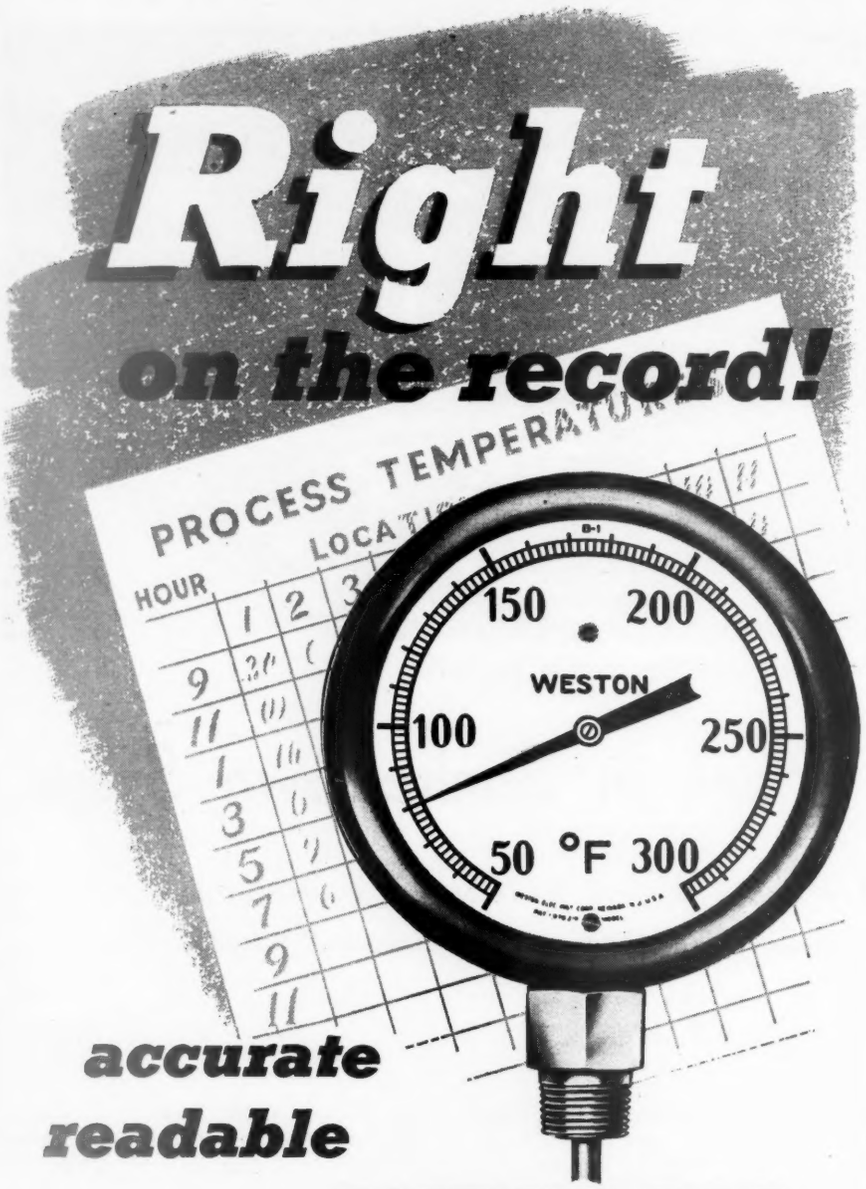
*Refining and Gas Processing Editor.



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of a catalyst, such as metallic cobalt, nickel, iron, etc., along with various small percentages of promoters or catalyst activators, to produce hydrocarbons and oxygenated chemicals. This synthesis was employed widely in Germany prior to and during World War II, but "bottlenecks" in their methods prevented the process from becoming economically feasible, especially the low capacity of their reactors, and the almost insuperable obstacle of removing efficiently the great amount of heat produced during the two reactions in the design employed by the Germans.

At least four major, and numerous minor, advances have been made by American technologists, the results of which make the process commercially feasible, in the opinion of those responsible for its operation and success. These advances include the development of especially efficient catalysts, which produce the motor fuel type high antiknock hydrocarbons so much required by world economy; the adoption of the fluid principle of catalyst handling and reactor design; the improvement of the process for concentration of oxygen from the air so as to eliminate or minimize the amounts of inert nitrogen that must be handled through the process; and the adaptation of the synthesis to natural gas instead of coal.

Removal of heat generated in the process was probably the greatest obstacle to economic success of the German synthetic fuels industry. By the adoption of the fluid catalyst system, already well developed in American and British cracking operations, the heat can be removed in equipment entirely outside the reactor units, and throughput capacity per unit of equipment space, weight, and cost can be increased manifold. Also, cheap concentrated oxygen in purities of 90 per cent or higher is dependent on, among other items, the ability and cheapness of methods for heat removal in the oxygen concentration process. The Carthage hydrocol plant requires two 1000-tons-per-day oxygen units; practically all of the equipment in these units is of aluminum construction, welded by the use of an argon-shielded tungsten arc, working on plate as thick as 2½-in. thicknesses necessary to withstand the high pressures. Aluminum is used because of its high heat transfer rate and its excellent properties at the very low temperatures, (down to minus 275 F or lower), employed in the operation.

Basic plant design and the design of special equipment were furnished by Hydrocarbon Research, Inc. Detailed engineering and construction are being handled by Arthur G. McKee Company. * * *

Solvent Refining of Lube Oils

Operating methods to produce superior raw distillates for lube manufacture through use of a vacuum unit.

J. C. ALBRIGHT

COOPERATIVE Refinery Association, of Coffeyville, Kansas, recently placed in operation a modern vacuum distillation unit to process reduced crude in the second step of high quality motor oil manufacture. This unit pursues a method of accepting reduced crude from the revamped crude distillation unit that operates on Oklahoma and Kansas crudes, which has been topped and reduced to the desired composition by the extraction of all lighter products, including virgin gas oils, and lower boiling fractions. When the vacuum unit was completed and in condition for operation, Cooperative formulated a method for starting up after construction, which is applied, with minor variations, to subsequent start-ups after a shut-down for inspection and clean-outs during the turn-around. This method anticipates all the problems involved in such processes and provides a definite procedure that eliminates, by double-checking, the probable failures during succeeding periods of operation.

Particular emphasis is placed upon the method of firing the pipe still furnace in the initial phase of starting the unit when any repairs have been made to the refractory lining of the combustion chamber. The flames of the fuel burners are controlled for a gradual rise in temperature so the clay or chrome products employed for repairs dry slowly to preclude cracks due to rapid expansion of the surface and body of the refractories. Close attention is given to the readings afforded by the thermocouples to hold the temperature low enough that no ill effects will be reflected in the processing tubes and the steam superheater section of the pipe still. While the heater is being warmed up for drying, the entire cool-

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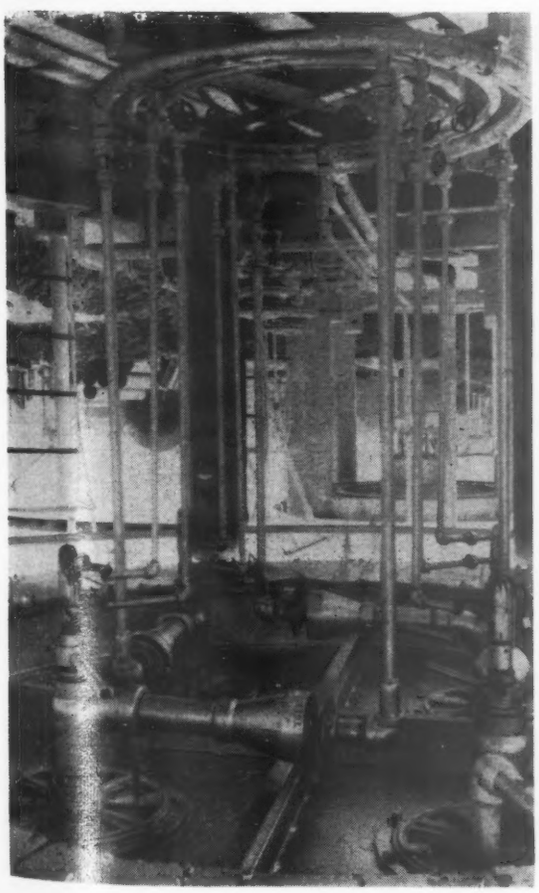
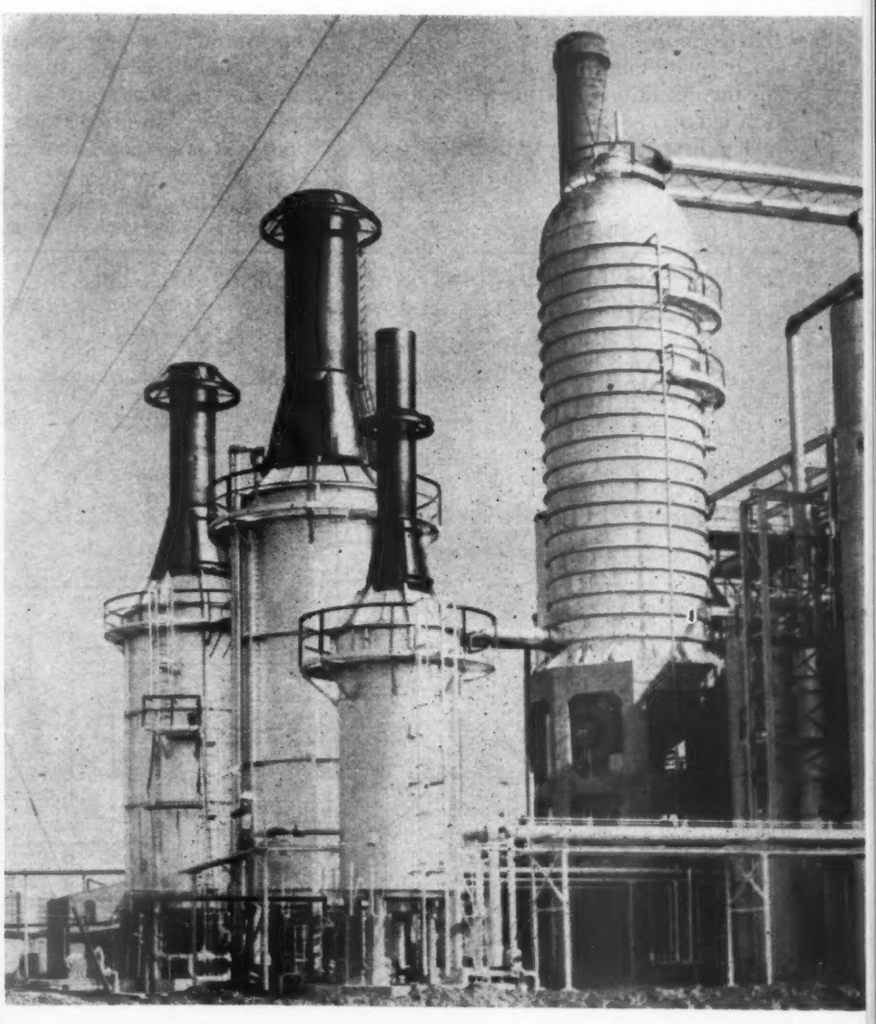
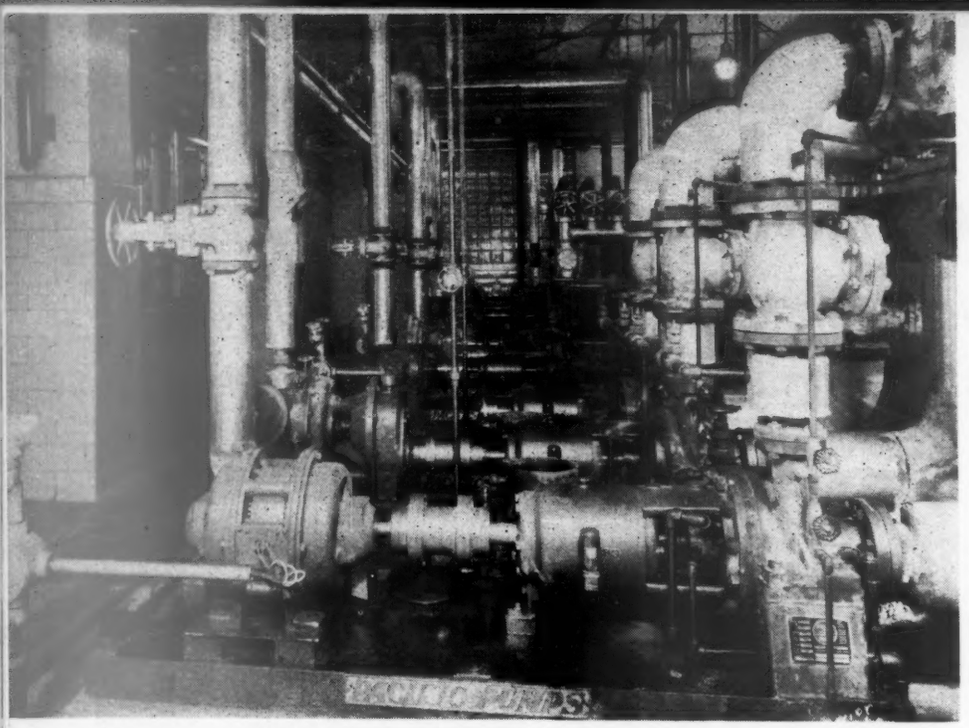


Concentric fuel feed headers below combination burners* beneath Petrochem heater in Coop's vacuum unit at Coffeyville, Kansas.

*John Zink.



Petrochem heaters in Coop refinery. Vacuum column at right.



Pump* room in Coffeyville refinery.

ing section is treated with steam under pressure to flush away any foreign matter, which may have accumulated during the preceding period of operation. When this section has been flushed, gates and valves are closed so that a preliminary test may be conducted with compressed air at 75 psig for the detection of fitting and connection leaks.

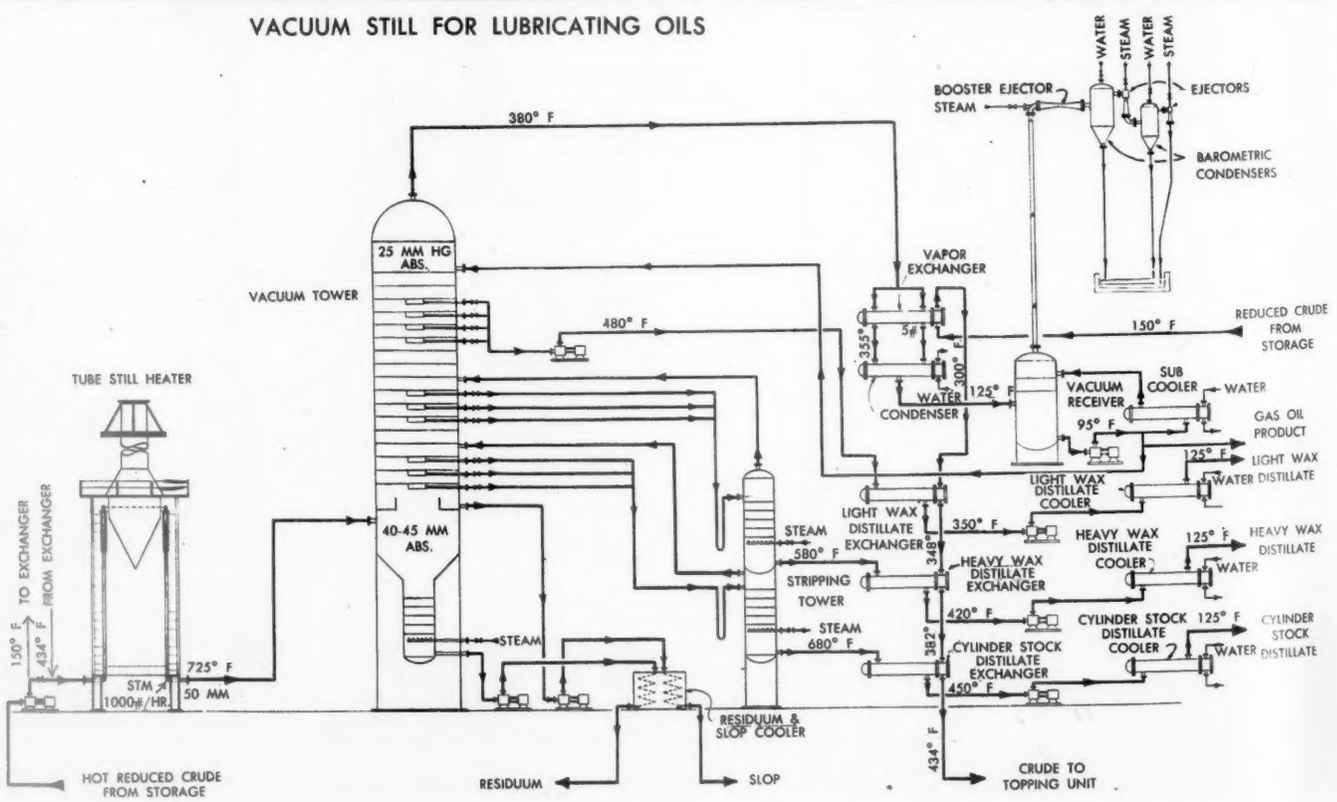
The first step taken to place the unit in condition for operation is to start the vacuum system by applying steam to the ejectors and to turn water into the barometric condensers. When this step has been taken, the vacuum equipment is permitted to function until the maximum vacuum has been obtained. The minimum reading on the instruments should be not more than 10 mm, and if this reading is not obtained, the condition indicates that some leak is in the system supplied by some opening to the atmosphere. In the meantime, the furnace fires are lighted, and circulation of the charge stock is begun by pumping through the process tubes of the pipe still into the main vacuum column, supplying sufficient reduced crude to fill the stripping section of the tower, but since this part of the system has small capacity, the charge can well show up in the main section of the column so that there will be an adequate quantity of oil for constant circulation.

As soon as the fires in the pipe still combustion chamber are lighted, both oil and steam are started through the tubes to protect against probable damage. Steam or steam condensate may be passed through the superheater tubes; condensate by evaporation prevents a rapid rise in the temperature of this part of the pipe still until the unit is in condition to start steam through various parts for processing.

The flow of processing material into and through the unit begins with the reduced crude that is pumped to the unit at a rate of 3500 bbl per day. The charge from the pump is led through the various shell and tube sections on the product side of the plant to obtain a gradual rise in temperature before the oil is admitted into the furnace tubes. Oil at storage temperature flows in sequence through the several exchangers with a final temperature of 434 F being obtained at the pipe still inlet. The Petro-Chem pipe still contains 43 radiant tubes in the processing section and has a heat absorption rate of 12,276,000 btu/hr for the charge and 2,055,000 for superheating

*Pacific pumps.

VACUUM STILL FOR LUBRICATING OILS



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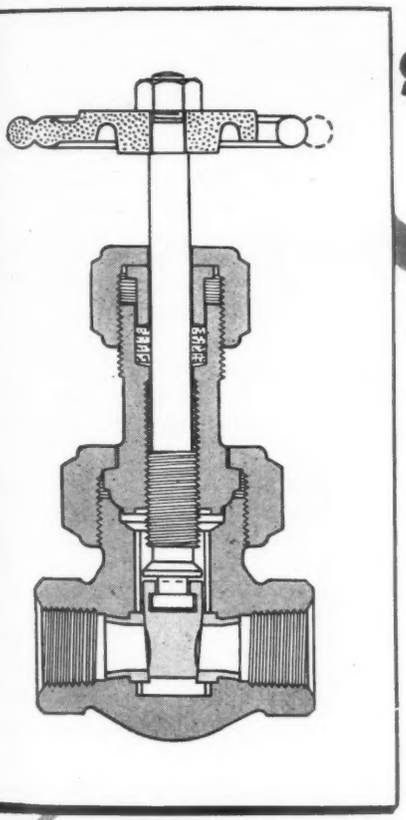

Operating men everywhere rate these valves as tops for general gate valve service including meter and gauge lines, drip and drain lines, etc. Series 9850 valves have drop forged carbon steel bodies and bonnets, rolled in 11½-13% chrome stainless steel seat rings which can be easily renewed, and a solid stainless steel wedge. A ground joint insures tightness between body and bonnet. The stuffing box can be repacked under pressure when the valve is open.

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Series 9850-F8 valves have 18-8 stainless steel trimmings and carbon steel bodies and bonnets.

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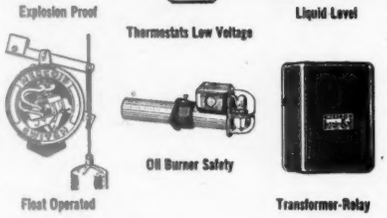

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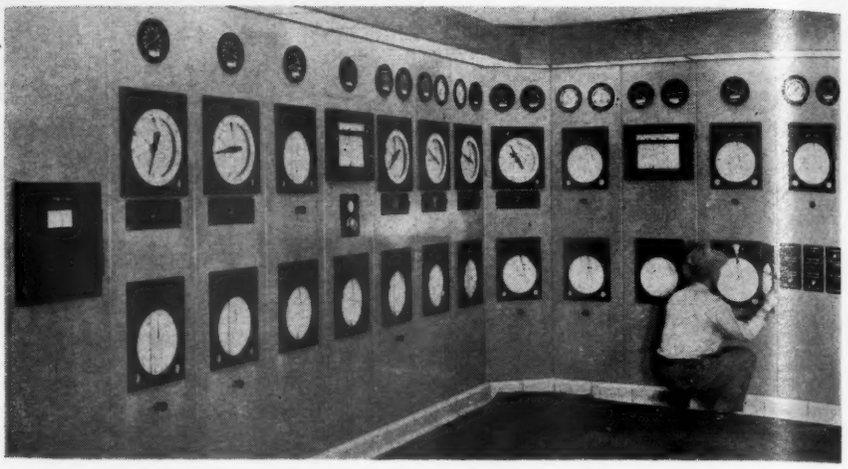


Control room showing instruments* in vacuum unit.

the process steam, all based on an efficiency of 69.5 per cent, calculated, when gas is supplied as fuel.

At 715 F, the oil travels through the transfer line into the main column under a pressure of 50 mm of mercury absolute. The main column has an ID of 18 ft and a height of 55 ft from head to head tangent. It contains a mist extractor above the process charge inlet nozzle, and is fitted with 17 trays and a slop drawoff pan. The base of the column is supplied with an integral residuum stripper, 5 ft ID and 11 ft 6 in. long, attached to the bottom head of the main column, and contains 5 stripping trays.

The overhead stream from the main column is a variable product as its characteristics are governed entirely by the composition of the charge stock and the specifications desired for the light wax distillate. These overhead vapors flow in series through a pair of shell-and-tube units to reduce the product temperature from an inlet of 380 F to 125 F at the inlet of the accumulator, or vacuum receiver. Product pumped from the receiver flows through a split stream to storage, to the top of the main column as reflux. The portion entering the receiver is conducted through a shell-and-tube sub-cooler to reduce the temperature to 85/90 deg to prevent any hydrocarbons from being pulled over by the vacuum units.

The light wax distillate is pumped from the drawoff pans near the top of the main column at 480 F and discharged into the light wax exchanger, which heats the charge in the first step of bringing up the temperature of the reduced crude. This product is subcooled to about 125 F for storing in the liquid state. The light and the heavy wax distillate and the cylinder stock are processed in a stripping column to produce a specification material. The top section is employed to prepare the heavy wax distillate by secondary distillation with steam that removes the lighter material led back to the main column above the product drawoff pans. The distillate is pumped through two exchangers in series to obtain a final temperature of 125 F for storage.

On a basis of 3500 bbl per day charge of Oklahoma City reduced crude, the product yields are as follows:

Charge	3500
Gas Oil	560
Light Wax Distillate	1211
Heavy Wax Distillate	665
Cylinder Stock	679
Slops	28
Residuum (Asphalt)	355
	3500

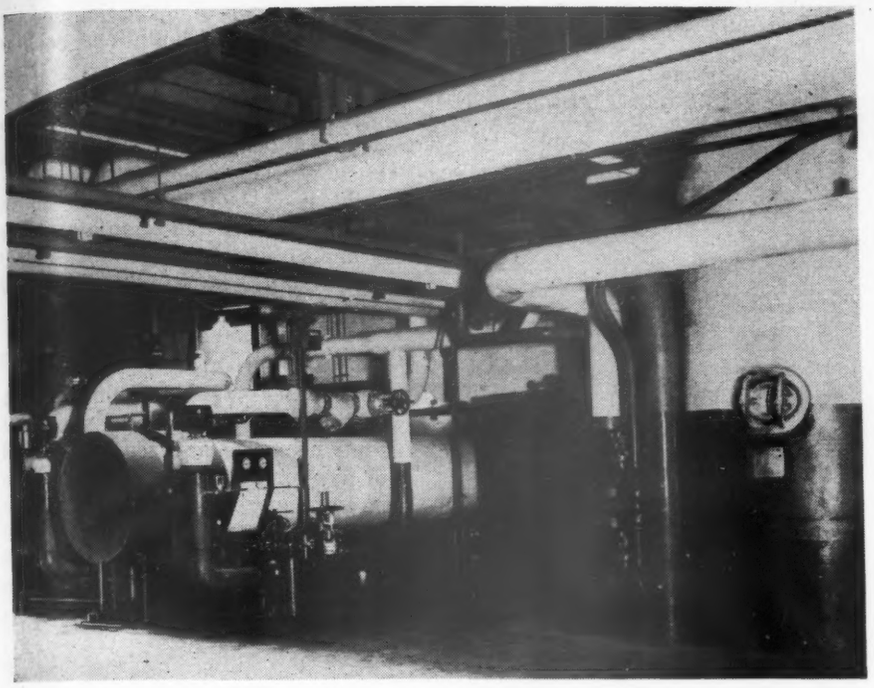
Typical specifications of the various products are;

Charge, Oklahoma City Reduced Crude—29 API Gravity.

Light Wax Distillate	
Vis @ 100	140
Pour	76
Flash	390
Fire	460
API Gravity	28.5
Heavy Wax Distillate	
Vis @ 210	70
Pour	107
Flash	510
Fire	570
API Gravity	25.7
Cylinder Stock	
Vis @ 210	175
Pour	120
Flash	605
Fire	680
API Gravity	21.9

* * *

*Brown instruments.



Nos. 1 and 2 fuel oil heaters at left and No. 1 drain tank at right are insulated. This is Sewaren Generating Station of the Public Service Electric and Gas Company of New Jersey.

Optimum Insulation Thickness

Data Presented Allows Calculation of Most Efficient Thickness for Any Installation.

ONE of the major problems of applying insulation is the ever present one of "How thick should it be for lowest cost and best results?" A method for calculation of the optimum and most economic thickness of insulation for any given set of conditions has been developed by W. E. Somers of Public Service Electric and Gas Company of New Jersey and is given here for the information of all interested in this field. This is the system employed by that company in all its operations.

The value of heat at any given point is determined first. This value is widely variable; it may be "$35 per 1000 Btu at a steam turbine, and only $2 at a boiler feedwater heater." The value decided upon finally takes into consideration not only the fuel costs and efficiency, but also evaluates amortization, overhead and all costs that should be considered. The cost of a given rate of heat loss, in 1000 Btu per hour, for the amortization life of the unit is determined.

Attention is given next to recom-

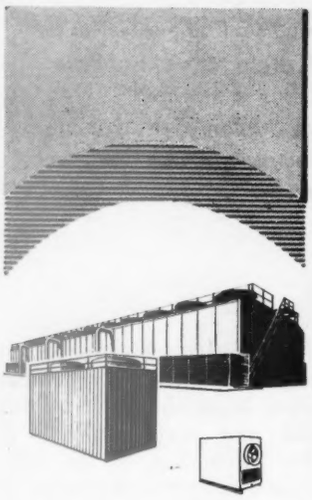
DETAIL SPECIFICATION
PART III—Ducts, Flues and Equipment

INSULATION DATA:

	(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)		(13)	(14)
Owner's dwgs. or print numbers	Internal or external application	Covering thickness high temp. (in)	Low temp. (in)	Cement thickness (in)	Hard finish cement thickness (in)	Insulation protecting cement thickness (in)	Weatherproof finish cement thickness (in)	Max. temp. (F)	Max. surface temp. (F)	Normal temp. (F)	Normal surface temp. (F)	Btu loss per sq ft per hour (based on norm. temp and 80 F ambient)	Guaranteed heat conductivity Btu per sq ft per degree temp. diff. per hr per inch (normal temp. adn 80 F ambient) High T.	Low T.	Heat evaluation $ per KBtu per hr	Area (sq ft)
Hot air duct A.H. to burner 43297-A-8064 ..... 43786-AB-3088	Int.	3½	.....	.....	.....	1	.....	690	°133	660	°129	°65.3	°.502	.....	$ XXXX	6607
Primary air duct 43784-AB-3088.....	Int.	3½	.....	.....	.....	1	.....	690	°133	660	°129	°65.3	°.502	.....	$ XXXX	1292
Tempering air duct 43787-AB-3088.....	Int.	1½	.....	.....	.....	1	.....	80 (a)	°	.....	°	°	°	.....	(a)	96
Pulverizer air duct 44614-AB-3095..... Print 43066	Int. Ext.	3½	.....	¼	¼	1	.....	690	°133	280	° 98	°21.3	°.420	.....	$ XXXX	3582
Recirculating air duct... 44142-B-9123.....	Ext.	3½	.....	¼	.....	.....	¼	690	°133	660	°129	°65.3	°.502	.....	$ XXXX	334
Dust collector hoppers Print 44459.....	Ext.	1½	.....	¼	.....	.....	¼	314	°	284	°	.....	.....	.....	p	3675
Induced draft fans Print 42668.....	Ext.	1½	.....	¼	.....	.....	¼	300	°	270	°	.....	.....	.....	p	1377

p — Protection only.
(a) — Insulate for 70 F differential between air in duct and outside air.
° — Contractor to furnish information in spaces marked thus.

SPC. 48-5036.



COOLING TOWERS

"That Pritchard Tower Is Sure Doin' A Job For Us"— Says Refinery Superintendent.

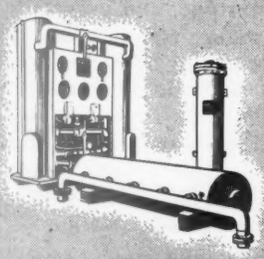
We got a tough assignment back in '49. Our customer needed a tower which would cool more than 4,000 gallons of recirculating water per minute from 105° down to 85° F., only 5° above the ambient wet bulb temperature. His entire process depended completely on 85° water —there could be *no* excuses! Could we do it?

We could, and we did. A few months later the Pritchard series "J" Induced Draft Cooling Tower with separate coil shed pictured above was put into operation.

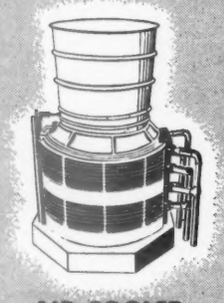
Today, according to the plant superintendent, this tower is consistently equalling or exceeding the design performance in accordance with the test procedures outlined by the ASME, with the operating crew taking their own test readings.

Naturally, when additional water cooling capacity was needed by this customer recently to take care of further plant expansion, another Pritchard Cooling Tower was *specified* for the job.

Why don't you, too, find out about the advantages of using Pritchard Cooling Towers in your plant? Consult your nearby Pritchard representative for full information.



GAS EQUIPMENT



AIR COOLED HEAT EXCHANGERS

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mend thickness of insulation for the given temperature conditions, such as the values given in CS117-49, "Mineral Wool Insulation for Heated Industrial Equipment", U. S. Department of Commerce, Washington, D. C.* Thus, a unit operating at 270 F would use 1½-in. of insulation in block form. If the addition of another thickness of insulation will save 15,000 Btu per hour, with a $2 value on 1000 Btu, then

$$\frac{15{,}000 \times 2}{1000} = 30, \text{ therefore}$$

$30 may be spent economically for additional insulation. On equipment of any considerable size, this $30 will not pay for additional insulation and therefore more is not warranted. In case the heat value at the given point were worth $20, then the $300 will pay for a considerable amount of insulation and its addition is likely to be justifiable.

With this procedure the data in Table 1 have been determined. A contractor supplies the information shown in columns 8, 10, 11, 12, and 14. The company furnishes the data in columns 1-7 inclusive, 9 and 13. To select the lowest bidder to apply the insulation wanted, assume two bids. One offers to apply insulation for $700, which allows a 50 Btu loss per square foot per hour, and the second bidder proposes to install at $500 insulation that will allow 70 Btu loss per hour. Area of the unit is 6600 sq ft; heat is worth $2 per 1000 Btu per hr. Cost of lost heat for the $700 insulation will be

$$\frac{6600 \times 50 \times 2}{1000} = \$660. \text{ For}$$

the total cost, this makes $660 plus $700 equals $1360. Similarly, for the $500 job the heat loss cost is $924 and the total cost is $1424. In this case the more expensive insulation job is the more economical.

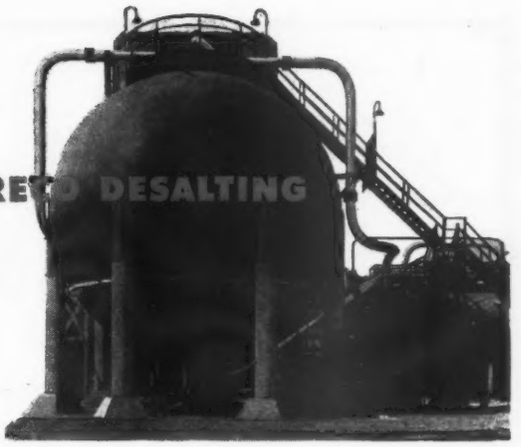
*Obtainable also from Industrial Mineral Wool Institute, 441 Lexington Avenue, New York 17, New York. ★ ★ ★

WPRA To Meet

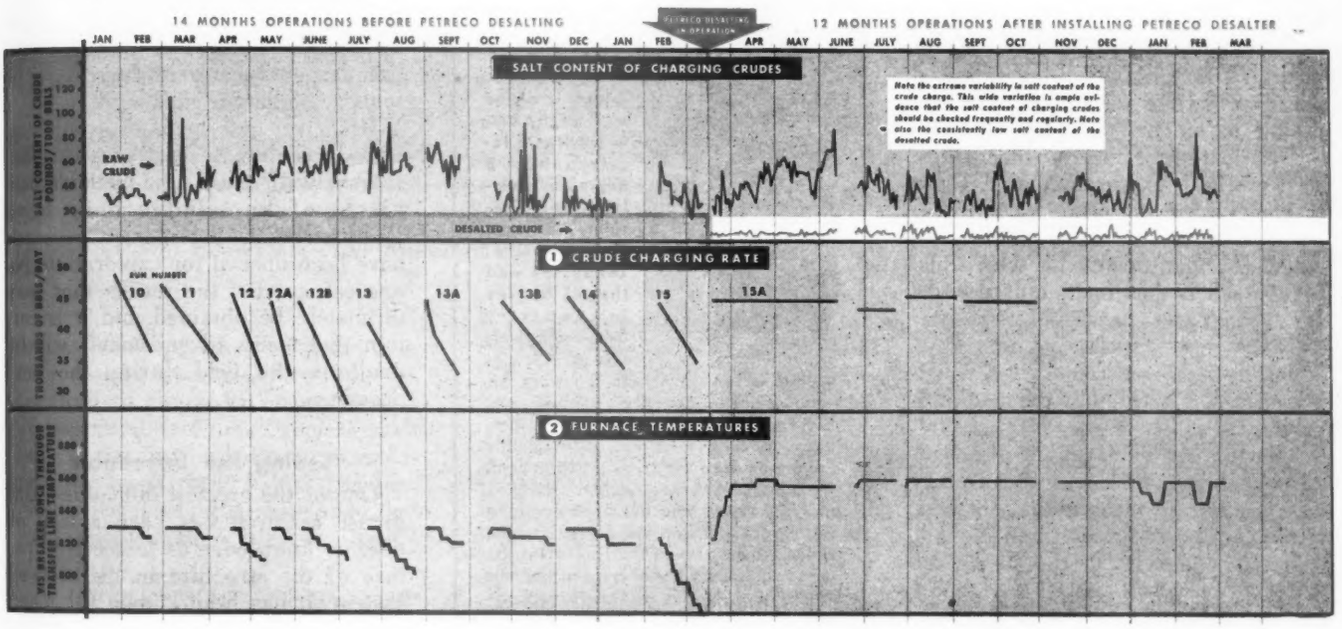
Lake Charles, Louisiana will be the location of the first of the 1951 series of regional meetings of the Western Petroleum Refiners Association. John C. Day, WPRA secretary, has announced that the meeting is scheduled for February 22 and 23 at the Charleston Hotel in Lake Charles.

The WPRA also plans to hold regional meetings in other refining centers during 1951. Tentative plans call for meetings in Wichita, Lansing, Michigan, Casper, Wyoming, and Tulsa. The annual meeting, usually attended by more than a thousand refiners from all parts of the country, will be held in San Antonio, April 2-4.

OVER TWO YEARS OF RECORDED REFINING OPERATIONS PROVIDE GRAPHIC PROOF OF BENEFITS FROM PETRECO DESALTING



For a 26 month period, 14 months *before* the Petreco Desalter was installed, and 12 months *after* the desalter was in operation, refinery personnel at a Texas refinery carefully observed and graphed the effects of salt on the operations of one unit. Particular attention was paid to the salt content of the charging crude and to the charging rates and furnace temperatures, both before and after installing the Petreco Desalter.


14 MONTHS OPERATIONS BEFORE PETRECO DESALTING
PETRECO DESALTING IN OPERATION
12 MONTHS OPERATIONS AFTER INSTALLING PETRECO DESALTER
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN FEB MAR
SALT CONTENT OF CHARGING CRUDES
SALT CONTENT OF CRUDE POUNDS/1000 BBLS
RAW CRUDE
DESALTED CRUDE
Note the extreme variability in salt content of the crude charge. This wide variation is ample evidence that the salt content of charging crudes should be checked frequently and regularly. Note also the consistently low salt content of the desalted crude.
1 CRUDE CHARGING RATE
THOUSANDS OF BBLS/DAY
RUN NUMBER
10 11 12 12A 12B 13 13A 13B 14 15 15A
2 FURNACE TEMPERATURES
TRANSFER LINE TEMPERATURE

The top graph shows the wide variation in salt content before desalting with Petreco, and to what low values Petreco reduced the salt in the crude charge.

Graph No. 1 shows how the comparatively high salt content of the crude caused the daily charging rate to decline. The effect of Petreco Desalting is obvious in the right hand section.

Graph No. 2 illustrates how Petreco Desalting permitted the use of higher *sustained* furnace temperatures. Before desalting, even the lower temperatures employed dropped off rapidly.

Petreco desalting does not necessarily benefit every refiner in exactly the same way, since refineries differ widely in charging procedures, flow schemes, and so on. However, regardless of the physical characteristics of the crude charged, the flow scheme of the refinery, or the type of refining procedures used, with every installation, Petreco Desalting has shown a rapid pay-out in improved operations, increased capacities and substantial maintenance economies.

Profit by the experience of the many refiners who rely on Petreco for the more economical operations assured by efficient salt removal. For further information, write or call

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PP 50-6

New Horizons of GREASE RESEARCH

GORDON S. BRIGHT

GREASES of one type or another have been manufactured for hundreds of years. In fact, it has been indicated that lime soap materials were used by Egyptians as early as 1400 B.C. for the lubrication of chariot wheel axles. It is natural to presume that these products were very crude partially saponified fatty materials. This prevailed for many centuries thereafter, for it was less than one hundred years ago that greases containing petroleum oils were known at all.

During the many centuries which preceded the age of mechanization, there was but little need for other than crude fatty lubricants. There were no high speed operations, and machines and methods of machining were very crude. It was not, in fact, until the advent of the automobile that any great demand for special greases arose. And even then there was a long period during which only "rule of thumb" and "trial and error" methods were used for the production of such lubricants. Only during comparatively recent years has research become a part of the evaluating and manufacturing procedure. Even so, during the development stage the grease makers without the benefit of scientific knowledge on the subject made many lubricants that were quite satisfactory for lubricating the equipment used during that period. The greases of 30 years ago, however, would hardly do for conditions of today. In turn, the lubricants of today will undoubtedly be far surpassed by the lubricants of the future.

During the days of lower speeds and less complicated machinery, grease making was strictly an art. It remained so for many years largely because of the complexity of the materials being used, the inclination of grease makers to guard their secrets, and the reluctance of institutions and refiners to spend large sums for fundamental research on other than the items of major importance such as gasoline and lubricating oils. In recent years that situation has changed. Because of greater and greater precision and higher and higher speeds, the need for specialized greases has grown tremendously. To supply these greases research has been necessary. Every large petroleum company now carries out a considerable program of grease research and expends considerable sums of money to develop lubricants suited to the needs of increasingly complex and demanding machinery.

Despite the increased emphasis on lubricants research, there are many problems that have remained unsolved. This is due in large measure to the lack of knowledge of the true fundamental nature of the soap-oil systems of which greases are formed. Results of changes in the systems could be evaluated and much knowledge has been gained on how to produce certain effects, but knowledge as to the causes of the effects has been difficult to obtain, largely because of the scarcity of tools available for such work.

Recently, new methods have been introduced to the field of grease research. With these new methods new vistas of knowledge have been glimpsed; new horizons of research have been opened for exploration. No one can predict the results that may ultimately be obtained, but it is certain that many advancements will be made in the field during the next decade.

The Author

Gordon S. Bright, a native of Smethport, Pennsylvania, received the A B degree in chemistry from Tusculum College, Greeneville, Tennessee and the MS degree in chemistry from the University of Cincinnati, Cincinnati, Ohio. Following his graduation, he accepted a position at Pfeiffer College in Misenheimer, North Carolina, where he was subsequently named head of the science department. He joined The Texas Company in 1941 and since that time has been engaged in work on grease research. He is at the present time assistant director of the Grease Research Department at the Port Arthur Laboratories of The Texas Company.

Seeing the Unseeable

One of the greatest difficulties with grease research has been a lack of definite knowledge as to the true nature of the structure in the soap-oil system. It has been known for many years that these systems are highly complex, but there has been no way to see the actual structure of greases. Simple visual observation indicates that there is a considerable difference in the texture of various greases, ranging all the way from buttery products with no semblance of fiber structure to the extremely fibrous sodium soap greases.

Visual observation is not enough however, to enable conclusion as to the nature of the soap structure in a given grease. More powerful tools are necessary. The most recent device for this work is the electron microscope.

Man is by nature, curious. He wants to see what is going on in the world about him. Early attempts were quite feeble in this respect but after the discoveries of Anton van Leeuwenhoek in the seventeenth century on the grinding of lenses, microscopes were gradually perfected which enabled the visualization of particles much smaller than can be seen with the unaided eye. But light microscopes have definite theoretical limits beyond which it is

EXCLUSIVE

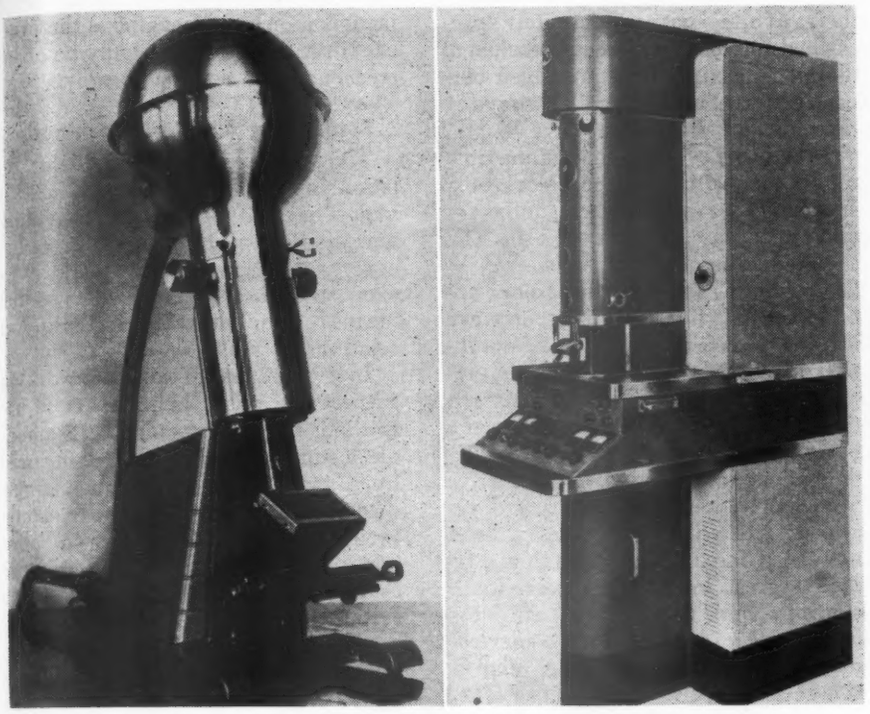


FIG. 1. Right, Universal model console-type RCA electron microscope. Left, permanent magnet-type electron microscope. Focused electron beams are used instead of light. *Courtesy RCA.*

impossible to go. Even with the best microscopes, therefore, very little was learned of the soap structure of greases because of the extremely small particle size involved. Progress in this field was temporarily halted therefore until a device could be developed that would enable man to "see" even smaller particles.

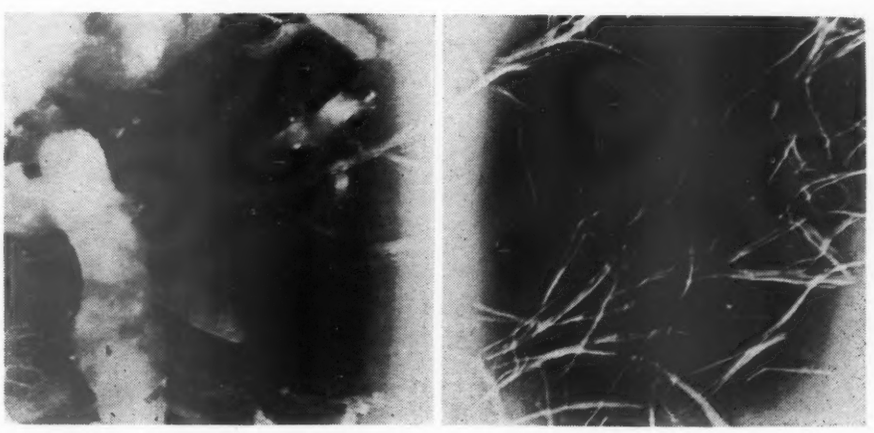
In recent years, the electron microscope has been developed. This device uses a stream of electrons (extremely small electrically charged particles) instead of a light source, and magnetic fields are used to focus the electron beams in place of lenses as in the case of the light microscope. With the electron microscope very small particles indeed can be photographed. As an aid to visualizing the extremely small size of objects distinguishable with the electron microscope, imagine for a moment that the smallest particle visible to the electron microscope were the size of the circle shown here. ○ Then the smallest particle that can be distinguished with the most high powered ordinary microscope would be almost three feet across; and the smallest particle distinguishable to the human eye would be about as large as an average city block! Using this analogy in reverse, if a city block could be reduced till it was so small that it could be barely seen, then a light microscope could pick out a card table set on the original city block, and the electron microscope could pick out a small marble on this card table. With such equipment it has been found possible at last to determine the shape and configuration of the soap fibers in various types of greases. Photographs of an electron microscope are shown in Fig. 1.

When greases are examined with the electron microscope, a whole new vista is opened. Cup greases, for example, have been considered for years as buttery, nonfibrous greases. An electron micrograph of a sample of cup grease is shown, however, in Fig. 2. It can be seen that the soap in cup grease is, in fact, fibrous, with the small individual fibers coiling about each other like a twisted rope. Experiments have shown that the amount of twist of the fibers is very definitely related to the extent of stirring during the manufacture. By means of this instrument, therefore, it may be possible eventually to correlate and control many of the variables of manufacture of various greases. This has not yet been possible, but may be a future result. It is one of the unexplored avenues of research.

Many different types of soap structure are found in different types of

FIG 2. Micrograph of cup grease via an electron microscope.

FIG. 3. Electron micrograph of another type of grease structure.



FIGS. 4 and 5. Two other types of grease structures. The physical characteristics of these products are, as might be surmised, quite different from those of the greases shown above.

greases as illustrated in Figs. 3, 4, and 5.

The application of the electron microscope to lubricants research is still in the very early stages of growth. As with any new scientific tool difficulties have been experienced; new techniques for handling very small samples must be developed, and because the information being obtained is new, a sufficient backlog of data must be accumulated before it can be properly interpreted. As time goes by, however, it may be anticipated that much information of real value will be obtained that will lead to a true understanding of the nature of greases.

Language of the Atoms

Although the particles of matter discussed in the preceding section are exceedingly small, there are yet smaller particles that are of great importance in the field of research. These are the atoms themselves. All material is made up of atoms that join together in various combinations to form molecules. Large groups of molecules form the particles discussed above. As powerful as the electron microscope is, the smallest particle that it can "see" is still a hundred times larger than an atom. Because the atoms are the fundamental building blocks of materials, however, it is very often necessary to know what kinds of atoms and molecules are present. Older methods for determining the presence of various compounds were often long and tedious; methods are now available to make the atoms announce themselves.

Atoms are made up of a central nucleus, in which is concentrated almost all of the weight, surrounded by electrons that travel in well defined orbits about the nucleus, much as the planets rotate about the sun. When the electrons are acted on by some external source of energy they may change their orbits, within definitely prescribed limits. When electrons change their orbits, light rays are given off: each different element emitting rays of definite and distinctive wave length.

Practically everyone has at one time or another witnessed the colors of a spectrum that appear when sunlight is allowed to pass through a prism. The same effect is observed, of course, in the rainbow. The different colors are produced by light of different wave lengths. This is the principle of operation of the spectroscope. The light given off by the excited atoms is passed through equipment that separates the various wave lengths, and since each type of atom has its own distinctive wave length, a definite pattern of lines appears. Hundreds of patterns have now been identified and cataloged so that a great many substances—both elements and compounds—can now be positively identified by the spectroscope pattern. Further, the relative amounts of various materials can often be determined by the intensity of the pattern.

The ability to ascertain the presence, or absence, of certain chemical elements or compounds quickly and in very small quantities of greases will be a great aid in grease research. Here again the ultimate value of such equipment is difficult to imagine at the present time. It will undoubtedly be of increasing value as time goes by.

Something New in Arithmetic

The study of numbers and their relationships is very old indeed, and it seems hard to believe that anything new along this line could still be discovered. Progress is being made, however, even here, particularly in the means for applying some of the known relationships to research.

In a great deal of research work on greases and oils it is necessary to use methods of preparation and methods of testing that may be influenced by a great many variables. A single determination of a value is frequently very questionable. But even after many determinations, questions arise as to the true value. Often a simple arithmetic average is not the correct answer. It is like trying to determine the exact distance between two marks a considerable distance apart with a one-foot ruler. After numerous measurements, it will be found that many of the values obtained are very close together. Occasional other values may be quite a little different. The question then arises as to which of the values, if any, should be excluded in averaging the results obtained. The

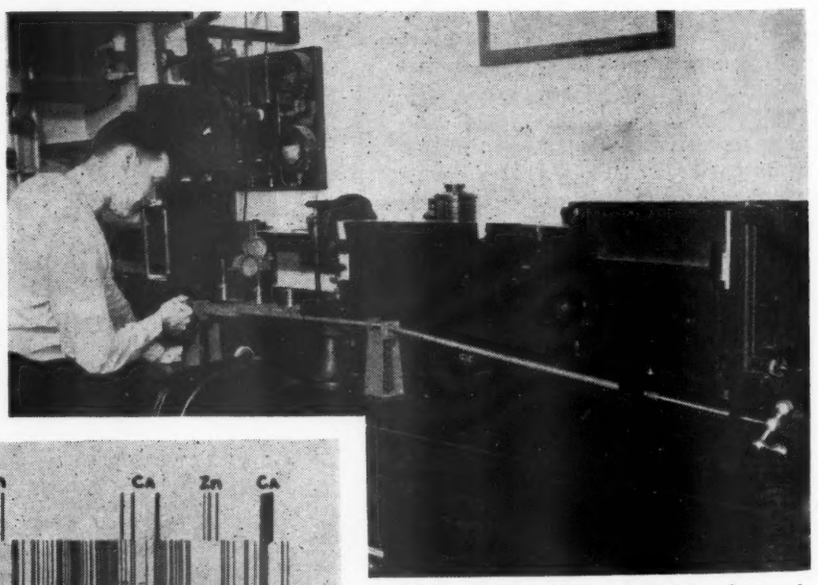


FIG. 6. Above, Bausch and Lomb quartz spectrograph in operation.

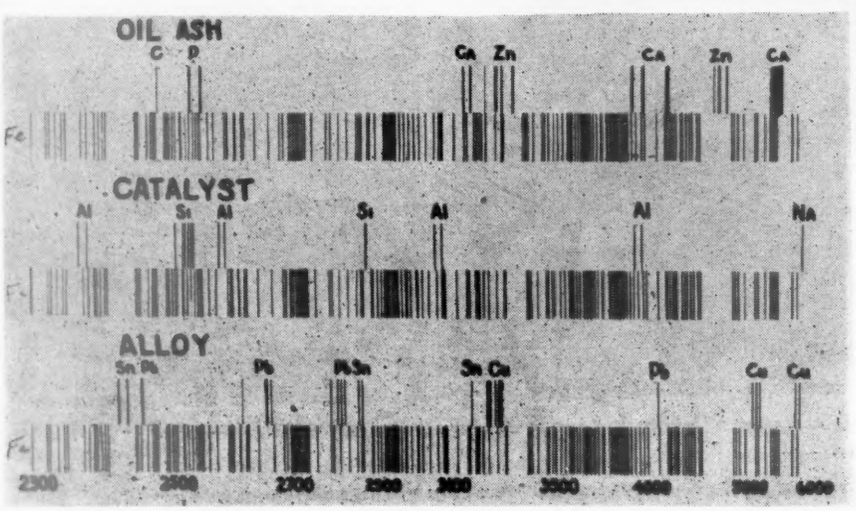


FIG. 7. Left, typical spectroscopic patterns.

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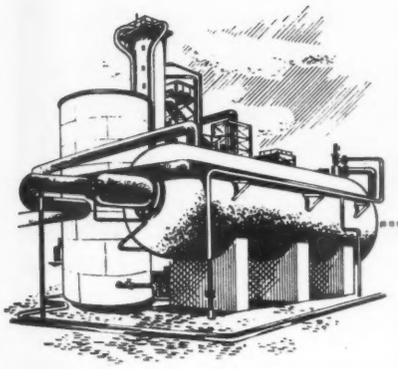
CHEMICAL DESALTING



Tret-O-lite Chemical Desalting increases refining efficiency by keeping essential equipment on stream. Salt-caused difficulties such as plugged towers and exchangers, corrosion from evolved HCl and the formation of hard, flinty coke in furnaces all result in short runs and high maintenance costs. By eliminating most of these troubles, and reducing others to a minimum, Tret-O-lite Desalting assures more time on-stream, with lower maintenance expense.

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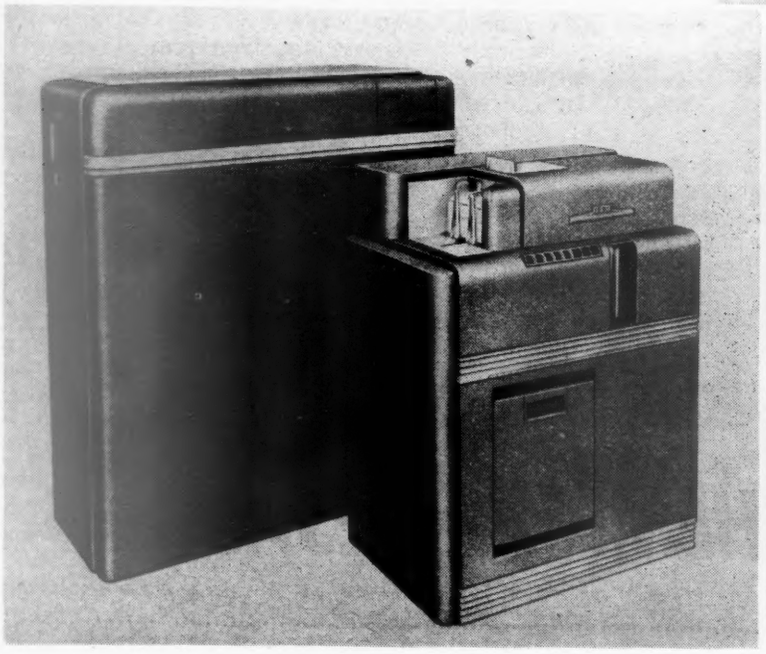
FIG. 8. A useful unit—
an electronic calculating punch.

Courtesy IBM Corporation.



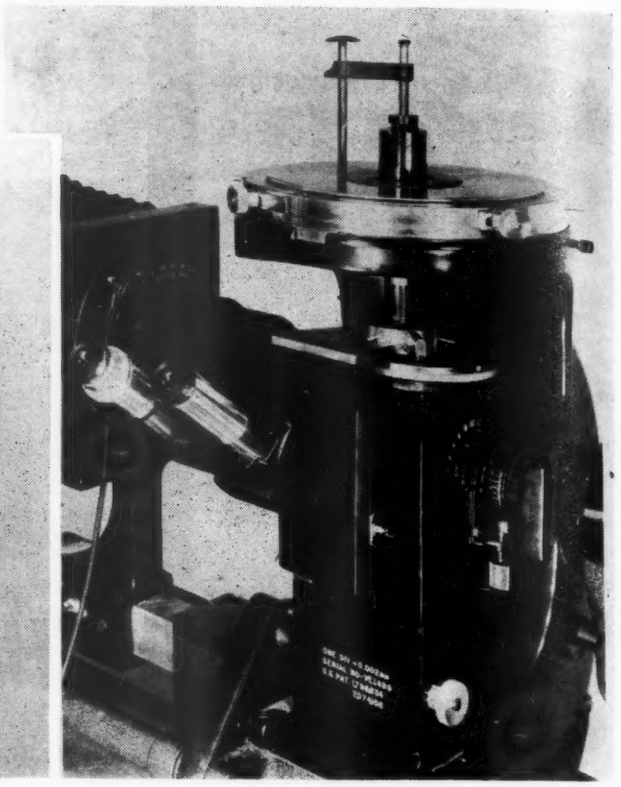


FIG. 9. A Bausch and Lomb research metallograph.

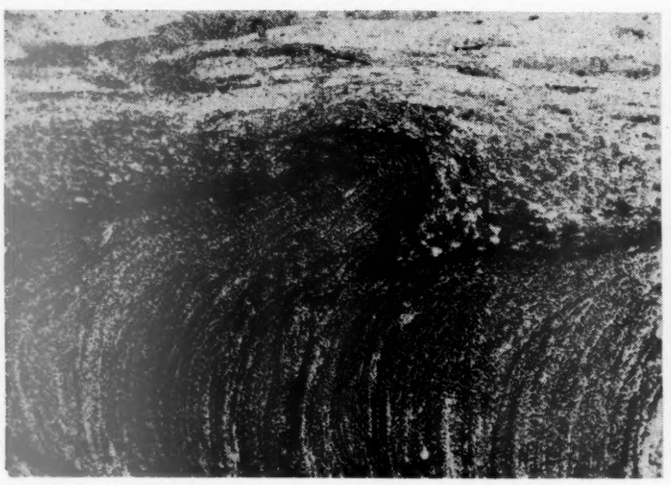


FIG. 10. An enlarged cross-section through an area in which a bearing has seized.

FIG. 11. Photomicrograph of a bearing alloy. The long thin irregular lines are those formed during the polishing of the specimen.

decision as to which values to accept and which to reject may be made on the basis of statistical analysis. Also, it is possible to determine from a large set of data, relating to a specific test, for example, which changes in values are significant and which are due only to variations in the test itself.

The principles of statistical analysis have been known for many years, but in many cases the mathematical calculations involved are so time consuming that application of the methods has not been practical. This difficulty has been overcome to a great extent recently, however, by the development of mechanical and electronic calculators that are more than human in their handling of numbers. Calculations that once took hours or days can now be handled in a matter of minutes, mechanically and accurately.

Data can be sorted and correlated in a variety of ways very quickly. This is another example of progress in the line of equipment and in methods that will have a considerable bearing on research.

New Ways to Service

In addition to some of the equipment which provides new methods of attack on problems of grease research as such, there have also been advances in special equipment which are of primary benefit in providing services to customers, but which also will aid materially in lubricants research. Typical of such equipment is the metallographic microscope. This microscope differs from ordinary microscopes in that it is designed primarily for the examination of opaque sur-

faces, particularly metallic surfaces, whereas the usual instrument depends on transmitted light.

Such equipment is of considerable value in service. An instance in which the microscope proved to be a facile tool was in diagnosing the cause of a recurring series of bearing-to-journal seizures on a heavily loaded grease pressure lubricated roll neck bearing in a rolling-mill. Although a theoretical analysis of the geometry of the running bearing (considering speed, load, size, and feed rate and body of the lubricant) indicated the installation should function satisfactorily, nevertheless, seizures were occurring.

Representative samples of the grease from a failed bearing, and a portion of the bearing metal itself, were submitted for microscopic examination. Two factors contributing to failure were detected.

The grease contained many particles of black, hard, mineral-like material recognized as fly-ash from the concern's power plant. On this point a subsequent investigation disclosed the fact that the grease hoppers supplying the lubricators were left uncovered and an abrasive ash from the near-by powerhouse gained ready access to the lubricant. In thin film lubrication, the presence of hard solids can disrupt the hydrodynamic film and thereby encourage metal-to-metal contact which, ultimately, can result in shaft seizure.

Examination of one of the seized bearings also contributed some vital information. Fig. 10 represents a cross-section through a region of seizure; the lower, fine grained material is the steel shaft; the upper, lighter-colored portion is the bearing bronze. Whereas a lubricating grease film had once existed between these two regions which, under the magnification shown (50X), would be essentially flat, the steel and bronze now were intimately locked together by the severe welding when lubrication was destroyed.

A higher magnification of the bearing alloy is shown in Fig. 11 where the grey background material is essentially a homogeneous solid solution of copper, tin, and zinc. The white globules and crosses were found to be iron, considerably harder than the bearing metal itself.

It is obvious that such a bearing material containing particles of the same degree of hardness as the mating journal would set up a very difficult lubrication problem, especially under the heavy loads and low speeds associated with rolling mill operation. In this particular instance, normal mill operation was restored by the substitution of a clean, leaded bronze bearing material and by providing a means of prohibiting the entrance of fly-ash into the lubricator.

Future Research

Although only a few of the newer implements for research have been reviewed here, it can readily be seen that activity in this field is very great. As time goes on, more and more specialized equipment will become available; and more and more will become known of the mysteries and intricacies of the fundamental nature of lubricants that have so long impeded the forward progress in this field. The horizons of grease research are indeed expanding and without question future research will yield much to enhance our present storehouse of knowledge. * * *

400,000 Outlets Sell Gas

In addition to the 188,305 service stations which market gasoline, there are about 200,000 retail outlets for motor fuel in country stores, garages and similar establishments, it has been estimated. These assure drivers of the nation's 44 million motor vehicles a contsant supply of motor fuel when they want it and where they want it.

ALCOA
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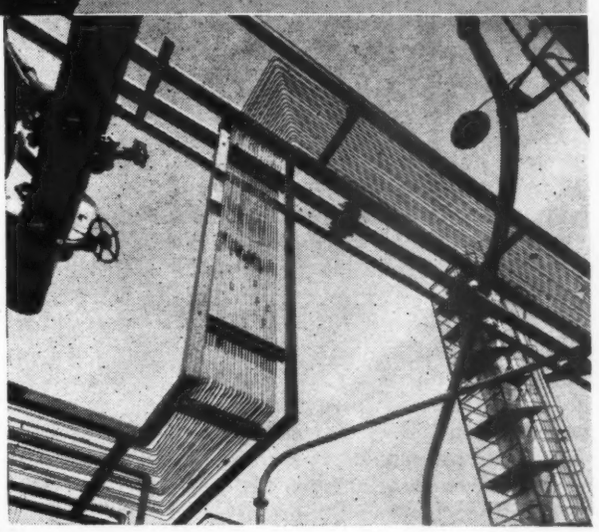

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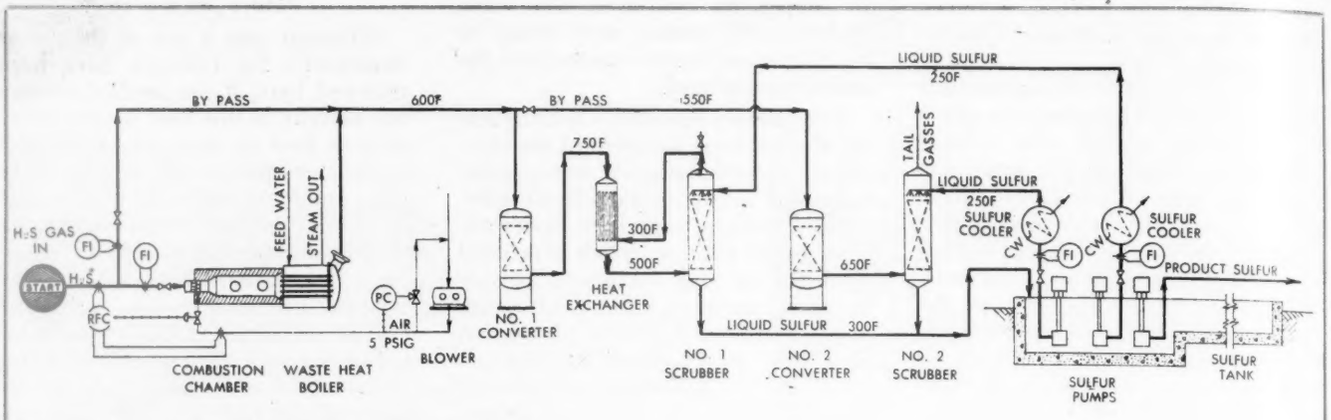


Process flow diagram for sulfur recovery plant.

New Sulfur Recovery Process

Up to 95 per cent of the sulfur in hydrogen sulfide-carrying gas may be recovered by this new process.

MANY natural gas, refinery gas, and liquid hydrocarbon purifying operations yield by-product hydrogen sulfide either alone or in combination with carbon dioxide. Disposal by the usual means of venting, flaring, or burning under a boiler not only creates an air pollution problem but also wastes a valuable raw material. In view of the present depletion rate of known mineral sulfur deposits, this latter has become an important consideration. An economical solution to these problems may be found in the conversion of hydrogen sulfide to elemental sulfur by means of a process offered by The Girdler Corporation of Louisville, Kentucky. Although the acid gas stream from a Girbotol plant is an ideal feed material, almost any H_2S or H_2S and CO_2 gas mixture may be employed. Generally a minimum of 90 per cent of the sulfur present in the H_2S may be recovered in a two-stage plant, and up to 95 per cent recovery is readily attained in commercial practice. A single-stage plant, however, designed to recover 80 to 85 per cent of the H_2S as sulfur, may prove more economical in smaller capacity installations. The quality of the product is equal to or better than bright Gulf Coast sulfur.

The Girdler sulfur recovery process is based on a modification of the original Claus process for carrying out the highly exothermic reaction:

$$H_2S + \tfrac{1}{2}\,O_2 \rightarrow S + H_2O$$

In order to remove the generated heat more efficiently and maintain better control over the process the above reaction is carried out in two steps as follows:

(1) $H_2S + 3/2\,O_2 \rightarrow SO_2 + H_2O$

(2) $2H_2S + SO_2 \rightarrow 3S + 2H_2O$

A typical flow plan for a two-stage plant is shown with the approximate temperatures indicated for a feed gas containing 90 per cent H_2S or higher. Reaction (1) takes place in the combustion chamber of a waste heat boiler where approximately one-third of the H_2S is burned to SO_2 and steam is generated in proportion to the H_2S burned. This may vary from one to two pounds of steam per pound of sulfur recovered, depending on the composition of the gas mixture, pressure of steam desired, and boiler efficiency. If more than one-third of the feed gas is introduced into the boiler, some sulfur may be formed according to reaction (2). This reaction is also exothermic and will result in the generation of additional steam. If hydrocarbons are present in the H_2S-bearing gas, however, it is important that complete combustion of those introduced into the boiler takes place there to avoid carbon deposition in the converters. In this case, not more than one-third of the gases should be burned under the boiler with the correct quantity of air for complete combustion. The flow sheet shows a sealed refractory-lined chamber connected with a fire-tube waste heat boiler in this service. Other types of gas-fired boilers with a combustion chamber designed for a slight positive pressure, however, may be employed if suitably modified for temperature control purposes.

Following the steam boiler the gases pass through the first converter where most of reaction (2) takes place and a gas temperature rise results. It is estimated that 70-80 per cent of the sulfur recovered is formed in the first stage and the balance in the second after intermediate product removal. The catalyst employed is activated bauxite that has an indefinite life, being subject only to mechanical failure. The converters are carbon steel vessels lined with a suitable sulfur resistant cement.

In order to remove the sulfur formed in the converter the gases are cooled to approximately 300 F and the sulfur is condensed. A heat exchanger is employed to cool the gases entering the first scrubber and reheat them before entering the second converter. Final cooling and condensation take place in carbon steel, Rasch-

EXCLUSIVE

ig-ring-packed scrubbers where the hot gases pass countercurrent to liquid sulfur. The circulating sulfur, heated in the scrubbers, returns to the sulfur tank carrying with it the newly formed sulfur. The tail gases largely consist of nitrogen, water vapor, carbon dioxide (if present originally), and small percentages of unreacted H_2S and SO_2.

Sulfur Tank Uses

The concrete sulfur tank not only serves as a sump for the sulfur circulating and product pumps but also as surge storage space. The liquid sulfur to be recirculated over the scrubbers is first cooled with water, as shown, or by other means. The product sulfur may be pumped to vats for solid storage, to tank cars or trucks for shipment, or directly to a subsequent processing operation such as a sulfuric acid plant. The pumps are vertical immersed-type centrifugal pumps especially designed for sulfur service. Liquid sulfur is held between 200 F and 300 F at all times to avoid the higher viscosity ranges above and below these temperatures, and piping is jacketed with 25 to 30 psig steam to keep the sulfur in a free flowing state. Steam coils are supplied in the sulfur storage tank to provide heat in case of shutdowns or excessive cooling from other conditions.

The principal controls required for a plant of this type are gas and liquid flow instruments and temperature and pressure recorders. The plant may be made completely automatic if the hydrogen sulfide content of the feed gas is essentially constant. Periodic analyses of this gas and the tail gas are sufficient for plant control purposes.

If used in combination with a Girbotol gas purification plant, the utility requirements of the sulfur recovery plant are minor. The steam generated in the waste heat boiler may be used to drive the pumps and blowers with the exhaust steam condensed in the Girbotol plant reboiler and condensate returned to the boiler. In many cases the major portion of the Girbotol steam requirements may be met this way. Cooling water for the sulfur coolers can be supplied from a recirculating water system, or, if water is scarce, other schemes may be employed using internal water sprays or air cooling to reduce the amount required. Other utility requirements include a small amount of electric power for compressing instrument air and other miscellaneous uses and fuel gas for start-up purposes. One man per shift can operate the sulfur recovery plant alone or in combination with a gas purifying plant. ★ ★ ★

NEWS

Canadian Refinery To Be Remodeled

A major expansion and modernization program for Imperial Oil's Sarnia, Ontario, Canada refinery was announced recently by J. L. Huggett, general superintendent of the refinery. When the program is completed, probably by the end of next year, Sarnia will have a plant of 71,000-bbl-a-day capacity designed to process Alberta crude oil in equipment of the most up-to-date type. Present capacity of the refinery is 55,500 bbl a day.

Tenders are being called for construction of a 46,500-bbl-a-day atmospheric and vacuum distillation unit, a 23,250-bbl-a-day fluid catalytic cracking unit, and a light ends recovery plant. The new units, along with increased boiler and water pumping capacity, will replace and augment existing facilities. The atmospheric and vacuum unit in which the first step is taken in processing crude oil, will be the largest single refining unit in Canada. The cracking unit is a new simplified design and will be the largest "cat" in Canada, Imperial reported.

Construction Under Way On British Refinery

Work is now going rapidly ahead on the new Kent refinery project in England of Anglo-Iranian Oil Company for which E. B. Badger and Sons (Great Britain) Ltd. have been appointed over-all co-ordinating contractors. About 800 acres of the company's property are now being developed on the south side of the Isle of Grain, which lies at the junction of the Thames and Medway estuaries. The refinery site is on marshy ground lying below the high water level of the two rivers, from which it is protected by a sea wall.

The first major item to be completed will be the crude-oil topping unit which, with gasoline stabilizers and copper chloride sweetening plant, is scheduled for completion in early 1952. Second stage of the project includes plant for lubricant manufacture and for improvement of products from the distillation unit. The lubricating oil plants will include vacuum distillation, propane deasphalting, furfural extraction, dewaxing and clay contact units, and ample blending tankage.

Plant for the improvement of products will include a vacuum flash unit, catalytic cracker of 10,000 bbl per day capacity, and various washeries and treatment plants. The boiler unit will consist of a battery of five 150,000 lb per hr boilers, supplying steam to 4 turbo-generators with an installed capacity of 16,000 kw of electric power, and will provide process steam for the plant operations. For cooling purposes salt water drawn from the Medway will be used; up to 4,000,000 gal per hour will be required.

Reactivate U. S. Section of French Chemical Society

In view of the opportune time at present, the American section of the Society de Chimie Industrielle has been reconstituted with the following officers: Worth Wade, president; Robert S. Aires and Jean R. L. Martin, vice presidents; council, now being formed, M. T. Bogert, F. S. Carver, Prosper Cholet, J. V. N. Dorr, Eugene Houdry, E. C. Kunz, D. F. Othmer, A. H. Waitt, and Jerome Alexander, honorary secretary.

Worth Wade is an executive of the American Viscose Corporation; Aries, consulting chemical engineer; Martin, is an executive of Coty, Inc. The members of the Council have been prominent in the chemical industry. Alexander, the honorary secretary, was one of the original founders of the American Section in 1917.

The reactivation has been effected during an opportune time because of the projected international chemical festivities in September 1951 in New York and Washington.

Octane Ratings Proposed

Gasoline octane ratings are to be limited by Petroleum Administration for Defense, according to announcement by Interior Secretary Chapman. The order will not be put into effect before consultation with the industry, he stated. The amount of reduction to be made official will be small, probably. On the East Coast premium gasoline runs 91 to 93 octane number ranging down to 88-89 in the Rocky Mountain region. Regular motor fuel ranges from about 87 on the East Coast to 80-81 in Rocky Mountain areas.

The order now proposed will hold premium grade fuel to 90, Secretary Chapman said, regular or housebrand grade to 84, and an "intermediate grade" to 86. Result of this development is mainly that motorists in the eastern and northeastern part of the country will be affected. The objective is to release more tetraethyl for aviation and other fuels for the armed forces.

"The first duty of the petroleum industry is to supply the engine fuel needs of the armed forces," said Dr. Robert E. Wilson, chairman of the board of Standard of Indiana.

Shell's Provident City plant, which will deliver about 50,000,000 cu ft of gas daily to Texas Eastern Transmission Corporation. Towers in the absorption and distillation area can be seen in photo.

Shell Gasoline Plant To Begin Full Operation

Shell Oil Company's new gasoline plant at Provident City, Texas began full-scale operation last month, Joe T. Dickerson, the company's area manager, announced. Although the plant was completed in June, it has been operating at only 20 per cent of capacity while awaiting construction of a 110-mile, 16-in. pipe line for Texas Eastern Transmission Corporation, which will carry gas from the plant to Baytown, Texas. After a lengthy delay due to a shortage of pipe, the line has been completed and is now being tested preliminary to full operation.

The plant's design capacity is 60,000,000 cu ft of gas per day. Approximately 50,000,000 cu ft of residue gas will be dehydrated and sold to Texas Eastern. In addition, about 2500 bbl of liquid products—propane, natural gasoline, and distillate—will be recovered daily from the wet gas by means of high pressure absorption. The natural gasoline and distillate will be carried by pipe line to the company's Houston refinery, and the propane to railroad tank car loading facilities at Sheridan.

New Chemical Weed Killer

Standard Oil Development Company has been assigned a patent for a chemical weed-killer of selective oils to be used in ridding the lawn of crab grass. The compound for which a patent was granted to M. W. Swaney, H. L. Yowell, and J. F. McKay, Jr., is claimed to be more effective than other preparations developed. It uses phenyl mercuric acetate in sulfuric acid-treated kerosines and aromatic extracts of kerosines. The inventors claim that it gives a "single shot" kill, and the small amount of the acetate used eliminates any danger to animals.

B-A Processes Record Amount of Crude Oil

British American Oil processed 18,000,000 bbl of crude oil during 1950, largest volume in the company's history, M. S. Beringer, vice president, manufacturing, reported in a quarterly message to shareholders. By the beginning of 1952 B-A's refineries will have a total capacity of 23,000,000 bbl of crude oil per year. Largest single factor in the company's increased throughput during the past 12 months was the completion of the major expansion program at its Montreal East refinery, which more than doubled the capacity at this plant.

"Our Moose Jaw and Calgary refineries are presently operating at full capacity and an expansion project is underway at Moose Jaw which, when completed late this year, will double the processing capacity of this plant," Beringer stated. B-A's Clarkson refinery is also running its maximum volume of crude.

A new B-A refinery at Edmonton will be in operation this spring thereby adding another 2,000,000 bbl to the company's annual throughput.

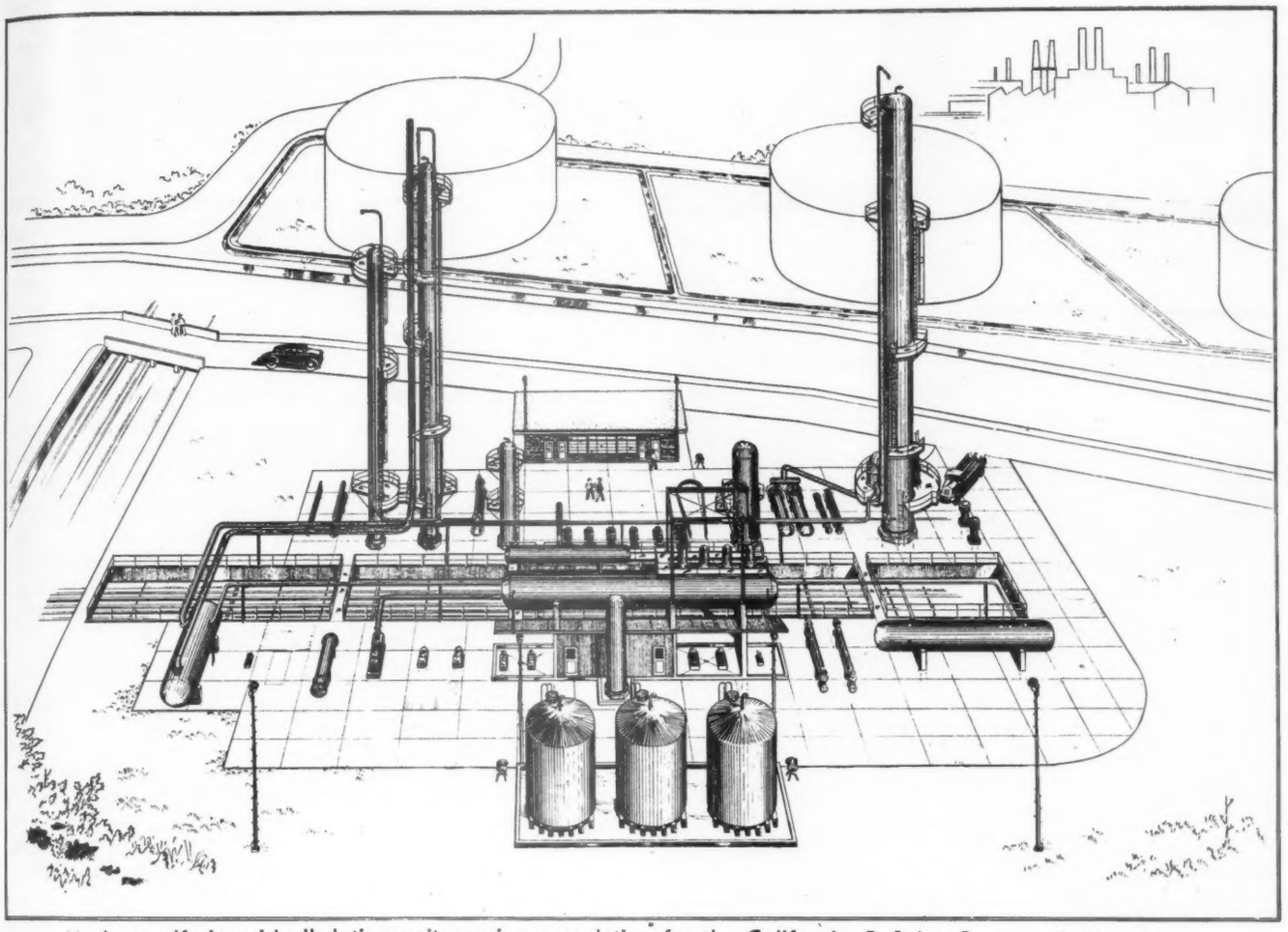
Socony Gets New Cracking Unit

Providing a 50 per cent increase in the refinery's capacity for high-quality automotive and aviation gasoline, a new air-lift Thermofor catalytic cracking unit went into operation in the plant of Socony-Vacuum Oil Company, Inc., Trenton, Michigan. It is one of the first units of its kind in the United States to use an air-lift for transfer of regenerated catalyst beads from a kiln to the top of a reactor where the beads are contacted with charge stock to "crack" it into gasoline components. Ten more such units are scheduled for other Socony-Vacuum refineries.

Three of these are at Beaumont, Texas, where two are already in operation at the refinery of Magnolia Petroleum Company, an affiliate of Socony.

Construction of the Trenton refinery's new TCC unit began last Spring. The contractor is C. F. Braun and Company of Alhambra, California. This new air-lift TCC unit, with a capacity of 15,000 bbl (42-gal) per day, replaces a cracking unit of the Houdry fixed-bed type which has a capacity of 10,000 bbl per day.

In addition to the Trenton refinery, Socony-Vacuum is installing new air-lift TCC units at refineries in East Chicago, Indiana; Buffalo, New York; Brooklyn, N. Y.; Augusta, Kansas; Paulsboro, New Jersey, and several foreign refineries.

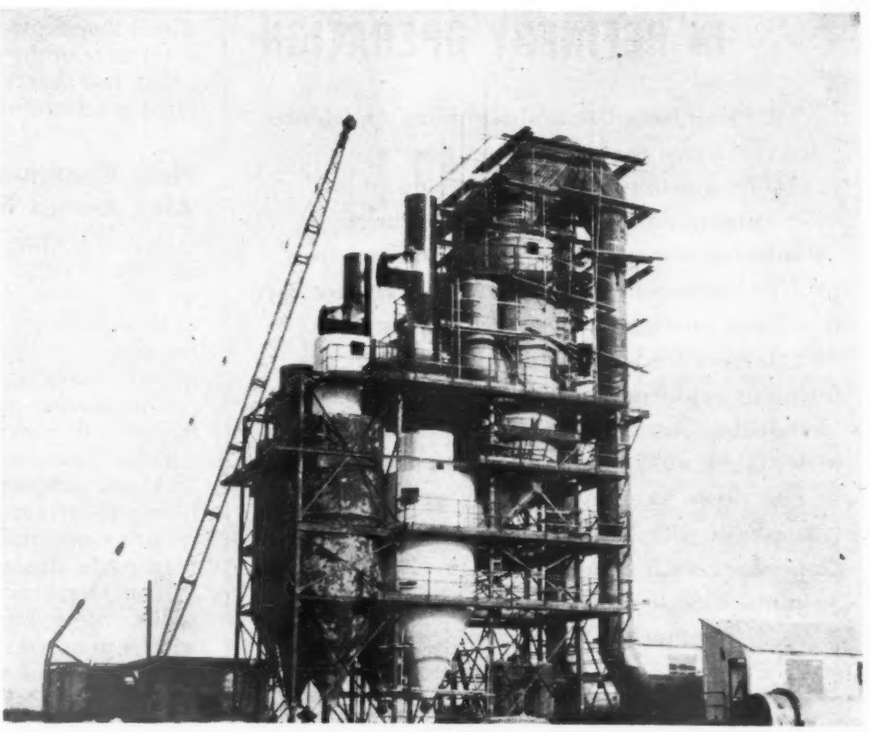


Modern sulfuric acid alkylation unit nearing completion for the California Refining Company in New Jersey.

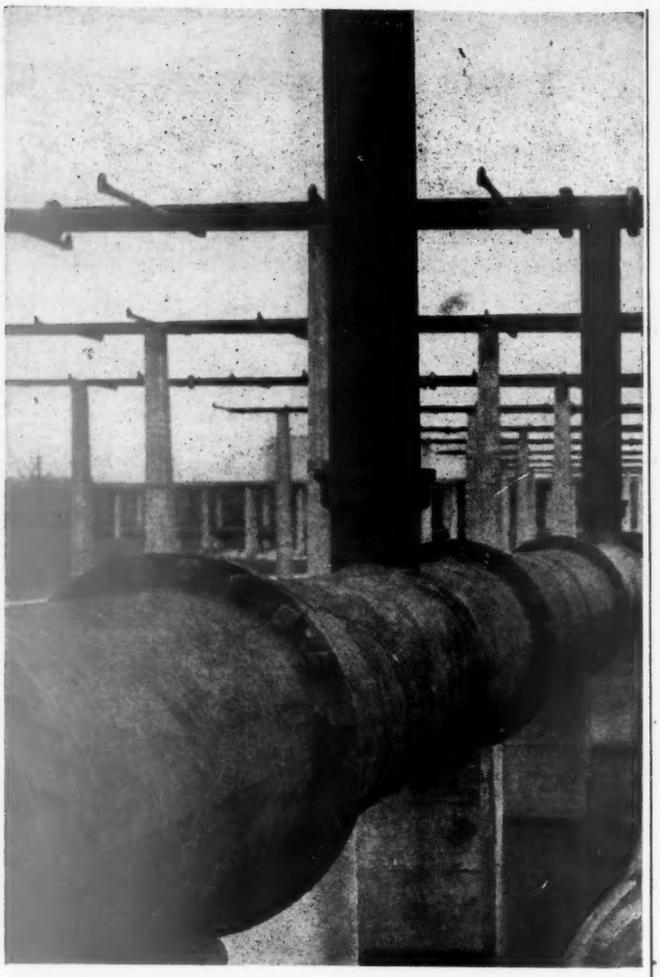
Modern Alkylation Unit Soon To Go On Stream

Nearly completed for the California Refining Company at its Barber refinery in Perth Amboy, New Jersey, is a 2180 bbl per day sulfuric acid akylation unit, which is scheduled to go on stream in early 1951, according to the engineers and builders, The M. W. Kellogg Company of Jersey City. Originally planned to help meet the "octane-challenge" of the higher compression engine, it is currently being somewhat modified to produce high octane aviation gasoline in view of increased military requirements. The modification calls for the addition of a re-run tower for fractionating alkylate into heavy and light products. This is not shown in the picture above but will be installed next to debutanizer tower at right.

When complete, the unit will be able to produce alkylate from a mixture of isobutane and either butylene or propylene. In the winter, when butylene is required for vapor pressure blending in refinery gasoline, it will operate on isobutane and propylene plus available butylene. At other times, the process will be normal butylene-isobutane alkylation.



Furnace carbon black plant of General Atlas Carbon Company, now under construction at Big Springs, Texas. The plant will consist of 4 units with a capacity of 50,000,000 lb black per year.



AN ECONOMY FACTOR
IN REFINERY OPERATION

Proved long life and stubborn resistance to corrosion make cast iron pipe a contributing factor in lowering plant maintenance per barrel of crude. Replacing shorter-lived pipe with cast iron pipe has demonstrated this in many refineries. Cost per term of service decreases. Interference with production, caused by frequent replacements, ceases to be a headache. Cast iron pipe works hand-in-glove with plant management to keep maintenance cost down in many refinery operations. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

Petrol Refinery Back in Operation

Petrol Refining Corporation is reactivating its Texas City, Texas refinery after 15 months of shut-down. The 30,000 bbl crude-oil refinery will employ approximately 150 men, D. E. Fuller, superintendent has reported. The refinery will make up to 100 and 130-octane avgas, 86 and 92-octane motor fuel, kerosine, No. 2 fuel oil, diesel oil, Bunker "C", and some excess isobutane. In 1948 Petrol Terminol Corporation purchased the plant, which was originally constructed by the Defense Plant Corporation in 1944. Officers of Petrol Corporation include V. A. Fogg, president; William H. Fetter, vice president and general manager, and William J. Fields, secretary-treasurer.

Refining Dividends Up in November

The Department of Commerce has reported that dividend payments of oil-refining corporations in November of last year amounted to $9,700,000, an increase of $300,000 over the corresponding 1949 year. During the 3 months ended with November, $62,000,000 above those paid in 1949, $171,800,000 compared with $109,900,000 the department reported. The dividends increase of refining corporations, was considerably greater than that of corporations as a whole.

Magnolia Refinery Completes New Air-Lift Thermofor Cracking Unit

Petroleum refiners from throughout the United States met recently at Beaumont, Texas refinery of Magnolia Petroleum Company, an affiliate of the Socony-Vacuum Oil Company, Inc., for inspections of an improved method of catalytic cracking for production of high-quality automotive and aviation gasoline.

Known as "modified, air-lift thermofor catalytic cracking units," the new Magnolia equipment will provide a 50 per cent increase in the refinery's output of high-octane gasoline in comparison with old-type Houdry catalytic cracking units which they replace.

Of three of the new-type TCC units on which construction began less than a year ago, two are now in operation. The third is scheduled for completion this summer.

New Continuous du Pont TEL Process Aids Armed Forces Requirements

A new continuous process for the manufacture of tetraethyllead (TEL) has been announced by the E. I. du Pont de Nemours Company, one of the foremost manufacturers of this product. This process comes to commercial development in time to aid in bolstering the requirements of our armed forces, the announcement points out.

Construction will start immediately on the first unit, which will provide 50,000,000 lb of tetraethyllead per annum. This unit will be situated at du Pont's Chambers Works at Deepwater Point, New Jersey, and is expected to be in production by January 1952. Contracts for both construction materials and for manufacturing materials have been made already. An important plant for this routine is that at Memphis, Tennessee, for making sodium cyanide, sodium being imperative for the making of TEL. The plant will be in operation also by January 1952.

The result of advancements in engineering design and important changes in the chemical process for TEL manufacture, the new system provides higher productive efficiency that will supplant the batch process entirely; also it eliminates the need for special steel alloys, now so critical for the batch process and also for immediate defense uses. The batch process has been used always for making tetraethyllead, a method developed by du Pont in 1923.

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For Replacement Service

Furnished with Adaptors to Fit Practically Any Instrument Case. Turrets Give Up To 11 Rotation Speeds

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STANDARD DRIVE FEATURES

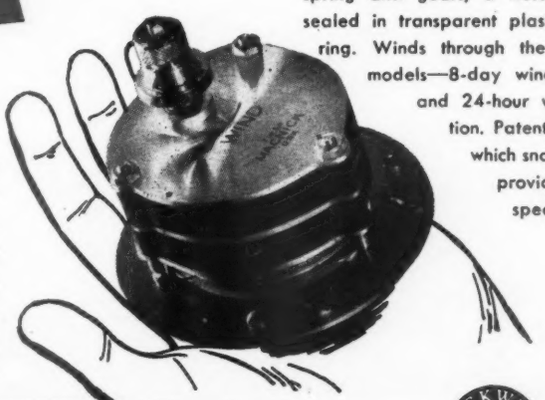
Dust proof, moisture proof case. Heavier mainspring and winding stem minimize principal causes of failure. Fitted with oil-sealed bearings, a single winding stem. Two basic models—8-day wind and 31-day wind. Turrets provide selection up to 11 speeds on one drive.

MIDGET DRIVE
obtainable on specification in most instruments

You can specify Rockwell Midget drives in instruments made by any manufacturer. The small size of the Midget allows more room for the other controls within the case and makes all the component parts readily accessible for service. Midget drives snap into a mounting ring which may be positioned on bosses or on adaptors to fit into any instrument case. In no other drive will be found the Rockwell combination of size, versatility, and high quality.

MIDGET DRIVE FEATURES

Made in three parts: the case, including mainspring and gears, a detachable escapement sealed in transparent plastic and a mounting ring. Winds through the chart arbor. Two models—8-day wind, 24-hour rotation and 24-hour wind, 24-hour rotation. Patented turret converters which snap on the main arbor provide a selection of 11 speeds on 8-day model.



Attractive factory repair program—WRITE FOR BULLETIN NO. 1079

ROCKWELL MANUFACTURING COMPANY
Pittsburgh 8, Pa.

Boston Chicago Columbus Houston Kansas City Los Angeles New York Pittsburgh San Francisco Seattle Tulsa

General Petroleum Completes Poly Unit

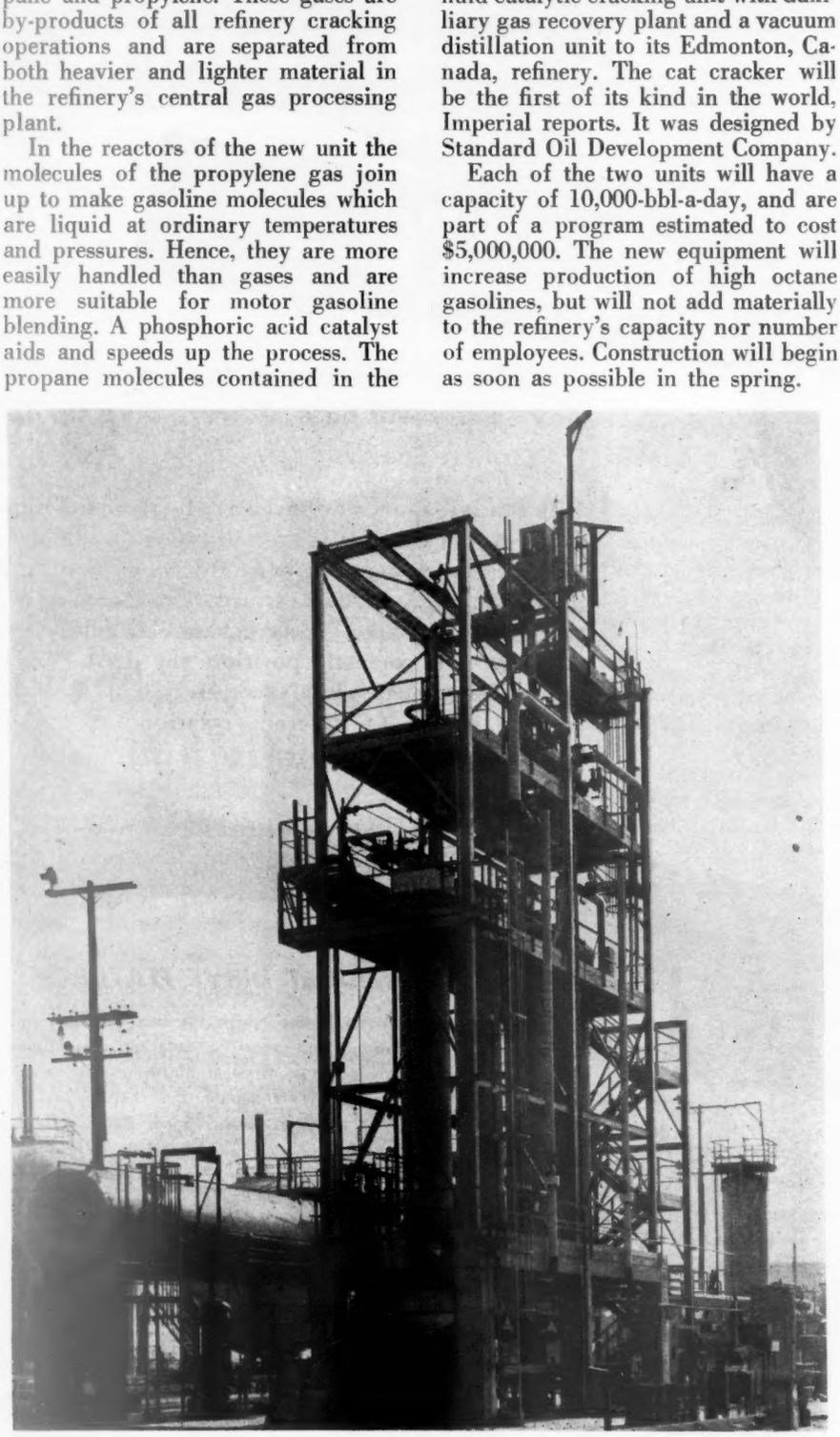
General Petroleum Corporation has added a new Lummus built catalytic polymerization unit to its Torrance, California refinery, which will provide about 700 bbl of high grade blending stocks each day for use in the refinery's output of motor gasoline. The new unit is fed with a mixture of two hydrocarbon gases, propane and propylene. These gases are by-products of all refinery cracking operations and are separated from both heavier and lighter material in the refinery's central gas processing plant.

In the reactors of the new unit the molecules of the propylene gas join up to make gasoline molecules which are liquid at ordinary temperatures and pressures. Hence, they are more easily handled than gases and are more suitable for motor gasoline blending. A phosphoric acid catalyst aids and speeds up the process. The propane molecules contained in the original mixture fed to the unit do not enter into the reaction. They remain in their original form and, after being purified, are sold as liquefied petroleum gas.

Imperial To Construct New Type Cat Cracker

Imperial Oil Company will add a fluid catalytic cracking unit with auxiliary gas recovery plant and a vacuum distillation unit to its Edmonton, Canada, refinery. The cat cracker will be the first of its kind in the world, Imperial reports. It was designed by Standard Oil Development Company.

Each of the two units will have a capacity of 10,000-bbl-a-day, and are part of a program estimated to cost $5,000,000. The new equipment will increase production of high octane gasolines, but will not add materially to the refinery's capacity nor number of employees. Construction will begin as soon as possible in the spring.



General Petroleum's new polymerization unit at the Torrance refinery, which builds 700 bbl of high quality gasoline daily out of what would otherwise be waste refinery gases.

Record Cat Cracker Shutdown for Turnaround

Sunray Oil Corporation's refinery at Duncan, Oklahoma, was shut down for turnaround on January 13 after setting a new world's record for continuous operations of a fluid catalytic cracking unit.

An inspection of the unit immediately after shutdown by F. L. Martin, the company's vice president for refining, and engineers of the Universal Oil Products Company, licensees for the unit, revealed a minimum of corrosion and internal wear despite the almost 2 years, continuous operations. In view of this it is estimated that the usual 4 or 5 weeks turnaround work to revamp the unit completely will not take longer than 2 or 3 weeks at the most.

The Sunray cat cracker has produced more than 4,050,474 bbl of high octane gasoline during the record-breaking run. Since the record run was begun in 1949, about 6,802,219 bbl of raw charge has been processed to the unit at an average daily charge rate of about 10,000 bbl. The "on-stream" efficiency of the Sunray refinery at Duncan has been calculated at 99.7 per cent. About 80 per cent of the more than 17,500,000 bbl of crude oil processed to provide the gas-oil charge for the cat-cracker was processed within the refinery itself.

The new record was set 677 days. On last November 8 the big Sunray plant passed the former continuous operation of 610½ days set by a California refinery in 1948.

Harbor College Trains Oil Industry Workers

Harbor Junior College, a technical institute in Wilmington, California, the heart of a great petroleum refining industry and the center of the Los Angeles Harbor area, recently inaugurated a program of on-the-job training for employees of industries in the area served by the college.

The program began with intensive training courses for employees of the Shell Chemical Corporation and the Minnesota Mining and Manufacturing Company. The training programs for each of the industries was intensive in nature, of two weeks duration, and provided basic operator training. They included lectures and laboratory demonstrations in physics, organic chemistry, safety and fire prevention, processing equipment, and instrumentation. The latest equipment and facilities used in the regular full time courses in petroleum refining, instrumentation, power plants, chemistry, and physics were utilized by the employees during their training.

NEWS

Lion Forms Natural Gas Department

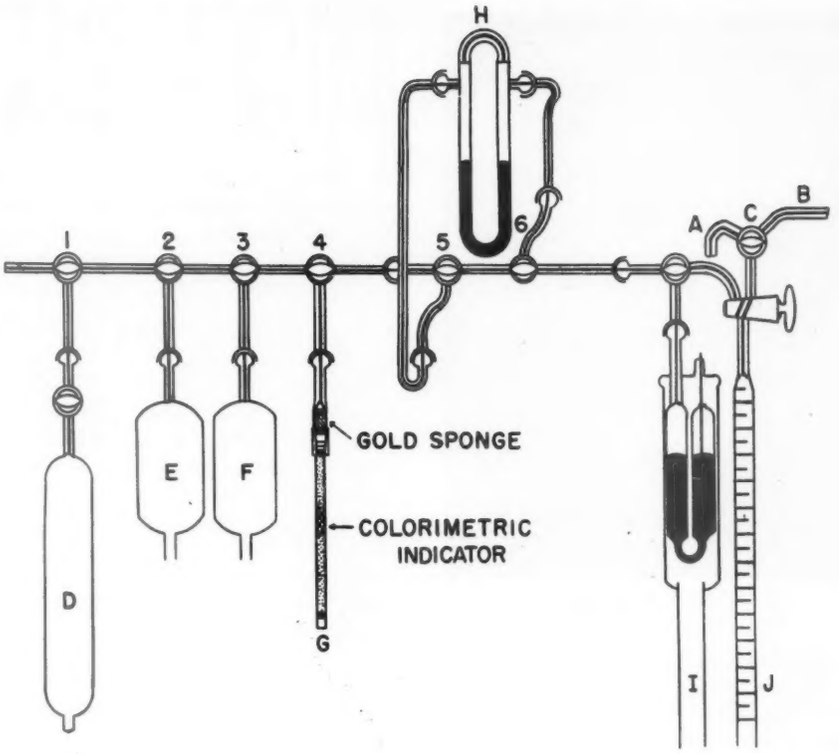
J. E. Howell, vice president in charge of production for Lion Oil Company, has announced the formation of a natural gas department of the oil production division of the company with William M. Wilson, formerly assistant superintendent of the refining division, as superintendent of the new department.

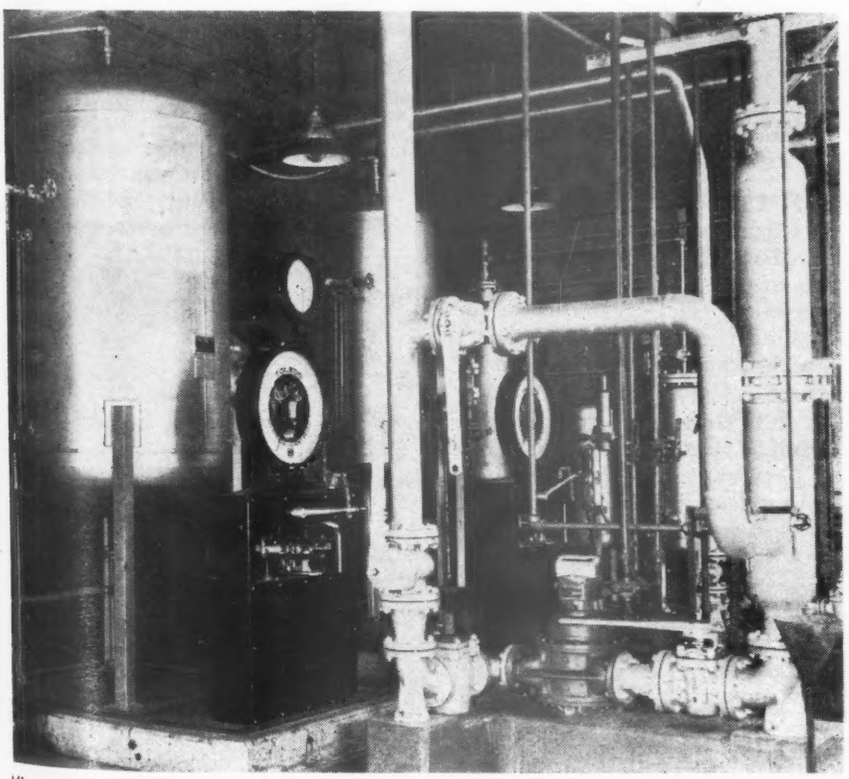
The company is now constructing a gas gathering system and natural gasoline plant in the Diamond M and Sharon Ridge (Canyon) fields in Scurry County, Texas, for a group of companies. Lion will operate the plant, which will have an ultimate capacity of 77,000,000 cu ft of gas per day.

Wilson, superintendent of the natural gas department, is completing 18 years of service with Lion Oil Company. Born in Kansas, he received his early education in Oklahoma schools and his technical education in petroleum refining at the University of Tulsa.

LPG Produced in Sumatra

Standard Vacuum Petroleum Mij. near Palembang in South Sumatra is producing liquefied petroleum gas commercially at its refinery in South Sumatra. Necessary equipment for LPG processing, storage, and cylinder filling has been placed into operation, and the product is being shipped to the Philippines. The need for LPG has grown as a result of war-destroyed municipal manufactured gas plants.





View of the inhibitor injection assembly for catalytic cracking and polymerization of gasoline at the Robinson, Illinois plant of Ohio Oil Company. (See The Petroleum Engineer, January 1951, Page C-27.)

New Oxygen Test Method

Elimination of the formation of carbon monoxide during the determination of oxygen by absorption with pyrogallol, which earlier caused inaccuracies, has been accomplished by National Bureau of Standards chemist Marthada V. Kilday, working to improve this method and eliminate errors.

The NBS monoxide indicator discovered during World War II has proved the important item in the improvement as it determines the amount of monoxide formed during any reaction, and is very accurate for CO concentrations up to 0.1 per cent, which can be attained by diluting samples containing more monoxide. One condition to be met is making solutions that form no appreciable amounts of monoxide by adding saturated potassium hydroxide to pyrogallol crystals in a vessel immersed in ice water and closed to atmosphere. Rate of flow of sample into the pyrogallol solution should be as rapid as possible, 20 ml per minute as a minimum.

The report of this work and of the details of the improved method are found in Journal of Research of the National Bureau of Standards, vol. 45, page 43 (1950) "A Quantitative Study of the Carbon Monoxide Formed During the Absorption of Oxygen by Alkaline Pyrogallol," by Marthada V. Kilday. Data on the carbon monoxide indicator are given in NBS Technical News Bulletin No. 354, page 73 (1946).

—PERSONALS—

Ralph R. Matthews

Ralph R. Matthews, internationally known refining and grease manufacturing authority, has accepted the post of executive secretary of the Independent Oil Compounders Association, (IOCA) president **Fred H. Helling** has announced. Known for more than 20 years as the vice president in charge of sales for Battenfeld Grease and Oil Corporation of Kansas City, a leader in and charter member of the National Lubricating Grease Institute, Matthews is known wherever lubricants are known.

A charter member of the U. S. Bureau of Mines petroleum division (San Francisco), he joined Roxana Petroleum Corporation (Shell) 'away back when,' as chemist, later was chief chemist of Roxana Wood River refinery; then organized and managed the lubrication department of Shell at St. Louis for several years. He joined Battenfeld in 1928 finally assuming the executive vice presidency of that company.

The list of 'pioneer' activities of Matthews is as long as the history of the oil industry. He made the first suggestion that the American Chemical Society have a petroleum division, and served as its chairman 3 terms; he worked for long years in and with committee D-2 of the Society for Testing Materials, and left his imprint on many of the present testing methods for oils and greases. He has been on the API Lubrication Committee for many years and has written a great number of technical and practical papers in his field. Forming a team with **C. J. Boner,** chief chemist of Battenfeld, he is a member of the Technical Panel for The Petroleum Engineer's Technical Forum.

The Independent Oil Compounders Association was organized in 1948, in St. Louis, to fill a need for a more closely knit organization among members of that large section of the industry. It held its first meeting in Chicago in October, 1948.

H. J. Monnik, chief engineer of the Catalytic Construction Company, will be project director of Catalytic's atomic energy division. Catalytic Construction is undertaking the design of a new uranium ore refinery for the New York operations office of the U. S. Atomic Energy Commission. The estimated completion cost of the refinery is $10,000,000. Location for the plant has not yet been determined.

Monnik has been chief engineer and director of the Catalytic Construction since its formation in 1946. Prior to this, he had been associated with the Sun Oil Company in its engineering department for 15 years.

J. F. Pritchard

J. F. Pritchard, president of J. F. Pritchard and Company of Kansas City, Missouri, has been elected president of the National Constructors Association, an organization composed of engineers and builders of chemical plants, steel mills and petroleum refineries.

J. J. O'Donnell, manager of personnel and labor relations of the Lummus Company, New York, was chosen vice president of the association. **C. B. Bronson** was re-elected full-time secretary -treasurer.

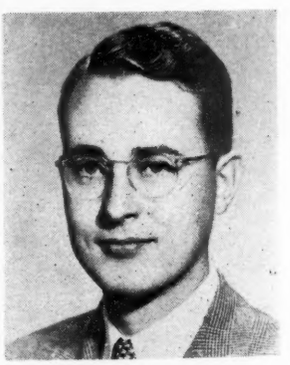
New members of the executive committee include **E. D. Hoekstra,** labor relations manager, The H. K. Ferguson Company, Cleveland; **W. Earl Dunn,** executive vice president of the Fluor Company, Los Angeles, and **J. M. Kelley,** vice president of Rust Engineering Company, Pittsburgh.

Chairmen of standing committees are **C. D. Haxby,** general superintendent of construction, Rust Engineering, labor committee; **W. Q. Ashley,** business manager, Foster-Wheeler Company, New York, foreign committee, and **F. R. Griffin,** safety engineer, construction and engineering division, Koppers Company, Pittsburgh, safety committee.

Charles R. Nelson, head of the process engineering department of Shell Development Company, Emeryville, California, has been elected director of the American Institute of Chemical Engineers. Nelson, a resident of Orinda, was born and educated in Pennsylvania. He received his B.S. degree in chemical engineering at Carnegie Tech in Pittsburgh. His advanced work, including a doctorate in chemical engineering received in 1935, was done at the University of Michigan. During the last 2 years, Nelson has made studies in his field of major interest, chemical plant design, in the Netherlands, the United Kingdom, and South America.

The Institute, a professional organization for chemical engineers was founded in 1908, and now has a membership of over 10,000 members.

Otto K. Wetzel, Jr., has recently joined the staff of Robert L. Purvin, consulting chemical engineers, of Dallas, Texas. Wetzel received the B.S. in chemical engineering at Massachusetts Institute of Technology. Prior to joining Robert L. Purvin, he was employed on the engineering staff of the natural gas department of Magnolia Petroleum Company, and in this capacity his activities covered all phases



Otto K. Wetzel, Jr.

of natural gas and gasoline plant operations. During this period, he devoted a considerable amount of time to the application of automatic controls in the handling and processing of natural gas. Wetzel joins the Purvin organization as process engineer in the Dallas office.

Pipe Lines and the Defense Program

As THE YEAR gets underway there is considerable speculation regarding pipe line construction under the national emergency set-up. This is the big question in private conversation and it was a question generally discussed among contractors at the annual convention of Pipe Line Contractors Association in Houston. Uncertainty comes from not knowing exactly what the policy may be in Washington regarding the degree of vitalness of pipe lines in the overall defense program. That they are vital both to defense and to the domestic economy is unquestioned, but there will be more curtailment in the matter of constructing new lines than under normal conditions. It will, of course, be necessary to show that a proposed line is essential before steel is allocated for that purpose. In this respect the pipe line industry is in a better position than some. The need for petroleum is well recognized and pipe lines transport by far the greater part of the crude oil and refined products, and, of course, all of the natural gas.

Even with restrictions, pipe line construction should be extensive during 1951. Many new projects have been announced, and any way the matter is viewed, it should be a good year.

Along this line, a plan is being drafted by the National Production Authority of the Commerce Department for allocation of steel and other metals to the military and essential domestic industries. It has also been announced that the Petroleum Administration for Defense will soon begin a complete transportation study from which it will be possible to determine what pipe lines are most essential to the domestic economy and national defense. This latter statement was made by PAD Deputy Bruce K. Brown. The outcome of both these activities is being awaited with interest. It should throw considerable light on the future.

Expenditures and Investments

INTERESTING DATA are given on the petroleum transportation industry by the American Petroleum Institute, which has completed a survey of capital investments and expenditures by the various branches of the petroleum industry. The report shows:

For transportation facilities, $324,000,000 was spent in 1950. This includes $120,000,000 for crude oil pipe lines, $74,000,000 for product pipe lines and $91,000,000 for natural gas pipe lines; $22,000,000 for marine transportation facilities; $7,000,000 for tank cars, and $10,000,000 for other kinds of transportation.

Construction of crude oil pipe lines was off somewhat compared with other recent years, but expenditures for natural gas lines in 1950 were nearly double the $49,000,000 spent in 1949, and more than double the annual average of $41,000,000 for 1946-49. Product pipe line expenditures likewise showed a marked increase. In 1949 they were $31,000,000, and the four-year average for 1946-49 was $41,000,000 a year.

Gross investment in property, plant, and equipment at the end of 1950 was $3,300,000,000, the report showed. This included $1,475,000,000 for crude oil pipe lines, $325,000,000 for product pipe lines, $1,150,000,000 for marine facilities, $275,000,000 for tank cars, and $75,000,000 for motor transportation.

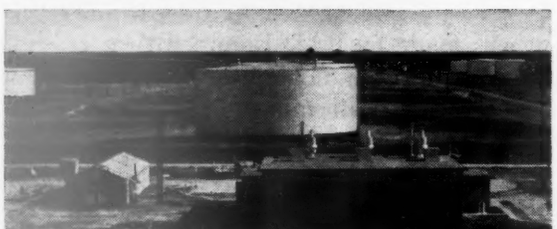
These facts serve to point up once again the vastness of the petroleum industry's transportation system.

Here's real pumping power for Pipe Lines

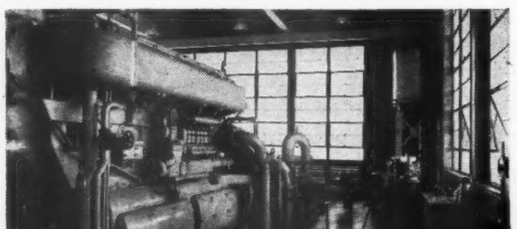
ALCO Diesel engine pumping installation at Patoka Station of The Texas-Empire Pipe Line Company System uses NO spare units.

Operation of these Alco diesels is so reliable that the Patoka Illinois Station uses no spare units—and yet must be ready at all times to pump vital crude oil by pipe line to refineries and connecting carriers. That's why Alco medium speed Diesels have been picked for the job. These dependable engines have operated 96% of the elapsed time at 94% of the manufacturer's rating, using centrifuged line crude for fuel. Operation is so reliable that the station uses no spare units. Such dependable performance is the chief reason why in the last ten years *more Alco Diesels have been installed in oil pipe line pumping service in the U. S. and Canada than any others.* For more details check now with American Locomotive Company, 30 Church Street, New York 7, or the nearest Alco Sales Office at Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady, St. Louis.

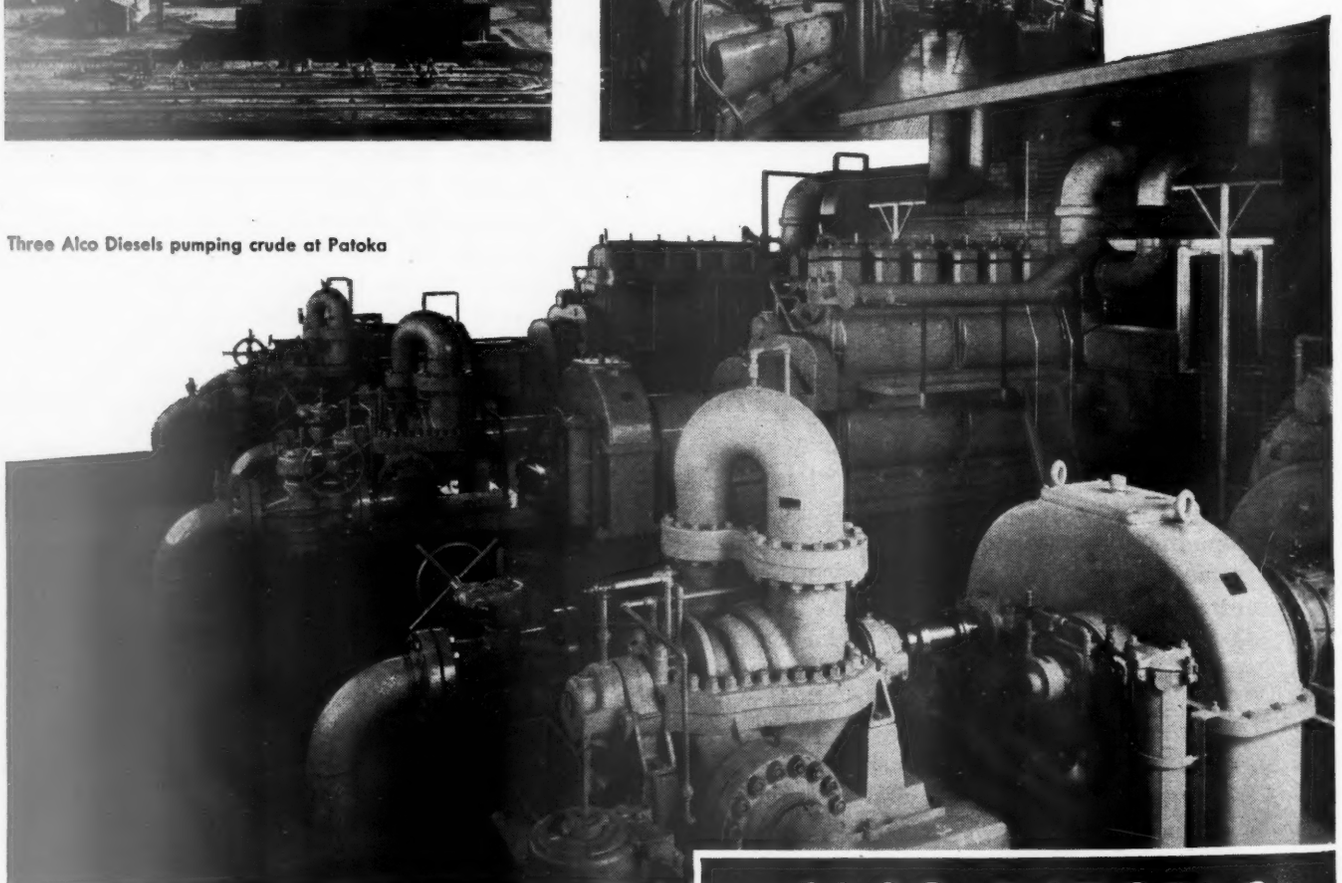
Outside view Patoka Pumping Station



Close-up view of one of the Alco Diesels at Patoka



Three Alco Diesels pumping crude at Patoka



SPEED Vs. WEAR

Remember, since piston speed and journal travel per minute are both almost the same in medium speed and slow speed engines, wear is equivalent as well. Not only do you get unequalled dependability with Alco Diesels—you get long wear and low maintenance costs, no matter how difficult the service conditions.

ALCO DIESELS

Alco

THE MARK OF MODERN ENGINEERING

AMERICAN LOCOMOTIVE COMPANY

Hot Applied Coat Tar Coatings

Here are answers to the questions: What are the characteristics of a satisfactory pipe line coating? How are coatings made and tested? What are the problems connected with their application in the field?

N. T. SHIDELER*

In Two Parts—Part 1

In recent years, the many oil and gas companies have become more and more corrosion conscious. So much so that practically all major companies and many smaller ones have established corrosion control and research sections devoted to corrosion alone. In addition, they have competent corrosion engineers on the job at all times. These are technical men who determine the type of coating to be used to mitigate corrosion. For that reason they should know what they are purchasing, the limitations, and characteristics of the coatings.

So much coal tar coatings or enamels have been, and are being, used that it is time that some facts concerning the coal tar coatings be given, if for no other reason than to acquaint the engineers with the coatings they are using.

Pioneering in selling, and the use of the coal tar coatings on oil and gas lines was done mainly during the 1920's. Since 1930, the use of these coatings has grown by leaps and bounds. At present, the major coating manufacturers are pressed to supply the demand. Last year the total tonnage of coal tar coatings approximated 250,000 tons. One sometimes wonders what has caused this demand and use; however, a study and understanding of the characteristics of the coatings show that they fulfill a definite need in the oil and gas industry.

Coating Requirements

What would be the characteristics of an ideal coating for pipe lines? The following points cover the major requirements:

1. Coating must adhere tenaciously to the metal.
2. Coating should be non-absorbent, impervious to water, moisture, vapors, etc.
3. Good di-electric qualities; not necessarily high but completely non-conductive.
4. Completely resistant to mineral acids, alkalis, salts, petroleum oils, and refined products.
5. A hard yet flexible coating at all temperatures between minus 40 F and 300 F.
6. A coating unaffected by soil stresses and movement of the pipe and soils around it.
7. A coating that will not permit penetration by stones, wires, welding rods, etc., found in trenches and backfills.
8. A coating, easily applied, preferably without heat or primer.
9. A coating that can withstand bending and rough handling without damage.
10. A coating that is quick setting or fast drying.
11. A coating that will give permanent protection to the pipe at the least cost of application.

Needless to say, coatings today are halfway to fulfilling the requirements, and with constant research going on will be improved and more fully fulfill the needs.

*Pittsburgh Coke and Chemical Company.

The Author

N. T. Shideler

N. T. Shideler left Wailes-Dove-Hermiston (later the Koppers Company) in 1948 to join Pittsburgh Coke and Chemical Company, his present affiliation. A 1926 graduate of the University of Indiana where he had specialized in chemistry, he spent four years in storage battery work after he left school before accepting a post doing research at Reilly Laboratories, Reilly Tar and Chemical Corporation. In the years since 1938 Shideler has also been associated with Steel Protection and Chemical Company, Mooresville, Indiana, where he developed coal tar base and chlorinated rubber base coatings, and Western Tar Products Corporation, Chicago. His later career has been devoted to the development, testing, and servicing of coal tar base coatings.

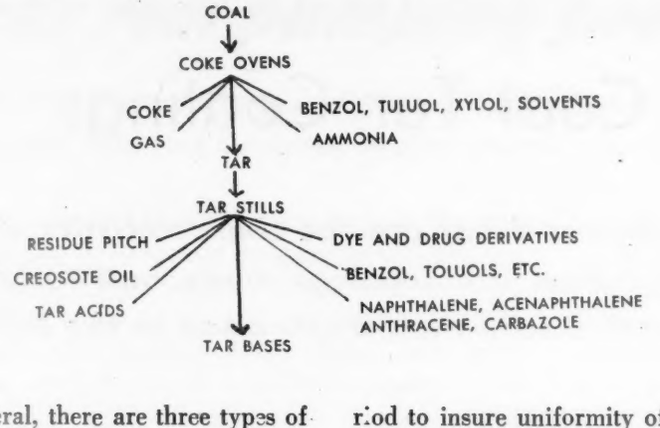
Coal Tar Coatings

Coal tar coatings are produced basically from coal tar as the name implies. The raw coal tar is produced by the destructive distillation of the bituminous and semi-bituminous coals. It is a by-product from coke ovens producing coke for steel production, or ovens producing gas for heat and illuminating purposes. The raw coal tar as condensed and separated from the coke oven gases consists chemically of a multitude of aromatic chemical compounds ranging from the simplest form benzol to very complex benzene ring compounds. Almost all coal tar compounds or constituents except the light solvents distilling below 175 C are heavier than water. The specific gravity of raw tar seldom falls below 1.150 at 60 F.

At the present time consideration will be given only to those coal tar coatings that are hot applied. The basic material for these coatings is the coal tar pitch. Pitch is the residue left in the still from the partial distillation of raw coal tar. The less oil distilled from the tar, the lower the softening point; the more oil, the higher the softening point and the harder the pitch. If the distillation be carried to the point where no more distillate comes off, the residue remaining in the still is pitch coke, almost pure carbon. The oils distilled off in these processes are normally termed creosote. Other compatible related materials, such as heavy creosote oils and coal, along with inert mineral fillers, are combined to make the coatings.

Diagramatically some of the products of the processes mentioned above are shown as follows:

EXCLUSIVE



In general, there are three types of enamels being produced today. To understand these types and tie in the type with the commercial coatings in general use, Table 1 gives a neutral name to each group or type with the manufacturer and trade name of their products.

Manufacture

The coatings fall into three groups primarily because of their composition and manufacture. The three names were selected because they more or less indicate the cold cracking and high temperature sag range of the enamels.

Narrow range enamel. The narrow range enamels are manufactured from coal tar pitch and mineral fillers only. The pitch for this grade must be from a selected tar distilled to a specific pitch softening point. Only a few of the many coal tars available are suitable for the production of this pitch. The pitch is produced in either a continuous or batch type still. The softening point selected is governed by the specification of the finished product and the rise in softening point brought about by the addition of the specific filler. In the plant, softening point of the pitch is controlled within a range of approximately 5 F to 6 F as is the final softening point of the enamel.

The filler is added to the pitch while the pitch is hot and quite fluid, and is incorporated by means of mechanical agitation, to obtain an intimate mixture of the pitch and filler. After checking the product for softening point and filler content, agitation is continued during the drumming period to insure uniformity of product.

This type of coating appears to be very simple to make, but there are many pitfalls in the manufacture that causes an off grade product, such as poor selection of tar, filler, improper distillation, softening point variations, improper amounts of filler, final softening point variations, settling of the filler in the coating while hot, etc.

Wide range enamels. The wide range enamels include those specified for coating and lining of steel water pipe, as specified by the American Waterworks Association. These enamels are produced from selected coal tar pitch, coal tar oil, crushed bituminous or semi-bituminous coals, and mineral filler. The process is much more complicated because of the use of the crushed coal and the necessary processing.

The charge to the producing unit consists of coal tar pitch, coal tar oil, and crushed coal processed to stability, yielding a stable plastic, ductile pitch. After stabilization, the pitch is adjusted to proper softening point and penetration, the mineral filler is incorporated, and the product tested, then drummed in the same manner as the narrow range enamel.

Just what part the coal plays is not clearly understood, but it is true that a properly produced product is very stable, and retains all the good qualities of the narrow range enamels plus the ability to withstand much wider temperature ranges. It is flexible, ductile, resists cold flow, etc.

Moderate range enamels. This grade of enamel is more or less an intermediate coating between the narrow range and wide range enamels. It is produced by a modification of the wide range enamels, or may be produced by blending the narrow range enamels with the wide range enamels, in the ratio of approximately 40 per cent narrow to 60 per cent wide range enamel. The characteristics of these enamels are about the middle between the other two enamels.

Primers. Primers are a necessary evil with all hot applied coatings. It is the bonding medium between the hot applied coating and the metal.

The primers for the most part are made from the same base as the enamels, with minor changes in softening point and other characteristics. That is, for narrow range enamel, a straight pitch of softening point (Ring and Ball) between 145 F to 160 F is used. Crude coal tar solvent distilling between 150 C and 200 C is blended with the melted pitch in sufficient quantity to produce a thin, fluid, paint consistency product that will dry rapidly on application to metal surfaces. The softening point of the pitch, viscosity of the product, drying time, and bonding characteristics are carefully controlled. After blending, the product is cooled, viscosity is adjusted, completely tested, then drummed. The moderate and wide range enamel primers are made by using in most cases the same coal tar solvent as for the narrow range enamel. The pitch used is the basic pitch of the enamel without the filler. Because of the presence of the coal in these products, the finished primer is not a solution of the pitch in the solvent as is the narrow range primer. but more nearly approaches, and probably is, mainly a dispersion of the pitch in the solvent. Because of these differences, much more care in the blending of the pitch and solvent is necessary to produce a suitable primer for these enamels. These primers are carefully laboratory controlled to insure permament bond between the hot applied coating and the metal.

Raw Materials

The raw materials have been mentioned before; they are coal tar pitch, coal tar oil, bituminous coal, mineral filler, and solvent.

Coal tar pitch. The tar from which the coatings are made must be a selected tar, because no two tars from different batteries of coke ovens are the same. The difference comes from the mixture of coals, inherent characteristics of the coal used to charge the ovens, the manner in which the ovens are operated, and many other points too numerous to mention. At any rate the tars vary a great deal. It is interesting, however, that in all character-

TABLE 1. Commercial coatings.

Manufacturer	Narrow range enamel	Moderate range enamel	Wide range enamel
Barrett company	180–190 F pipe line 190–200 F pipe line	Millwrap	Waterworks
Koppers company	XXH-Enamel XXH-Free flowing enamel	Bitumastic special No. 2	Bitumastic 70B Bitumastic 70B free flowing
Reilly Tar and Chemical company	Pipe line enamel		230° enamel
Hill, Hubbell company		Biturine Aqualine	
Pittsburgh Coke and Chemical company	Standard	Modified	Plasticized

istics except one, the pitches produced from the different tars make excellent coatings. The one point is the carbon content of the tar, which is reflected in the carbon content of the pitch and coatings produced from the tar. Certain types of carbon in the pitch reduce the di-electric strength of the pitch. It is indicated that most high carbon pitches are not resistant to electric sparks (jeep test) whereas low carbon pitches are quite resistant. As a result, if the narrow range coating is made from a pitch of low electrical resistance, the coating will show a large number of jeeps per square foot of coating on the pipe or steel in the field when tested for holidays. The interesting part of this is that actually such a coating has no holidays in it before testing with the jeep or holiday detector. The high voltage spark makes the holiday. If the applicator could be sure that there were no misses or thin spots in the coating underneath the wrapper, such coating would give excellent service because in service the line is never subjected to such high voltages.

Coal tar oils. Coal tar oils are used mainly in the production of the moderate and wide range coatings in order to obtain the softness, plasticity, and temperature ranges in these coatings. The oil is usually a fraction of the oil taken from the tar stills when the stills are producing high softening point pitch such as briquette pitch or fuel pitch and/or in carrying the distillation to coke in the still.

Bituminous coal. Not much can be said about the coal used other than that it is a selected coal used for the purposes mentioned above.

Mineral filler. Mineral fillers are used to strengthen and toughen the enamel. For instance, in narrow range enamel the pitch into which the filler is incorporated is so brittle that a small piece of it held in the hand may be crushed by merely squeezing, yet after the filler is added it is necessary to strike a piece of enamel with a hammer in order to break it. The addition of moderate amounts of fillers to the pitch does not drastically change the viscosity of the pitch, however, beyond certain limits further additions may make the pitch nonflowing.

Fillers are added to give strength and toughness to the coating, yet do not affect good flow characteristics at application temperatures. Mineral fillers also help to prevent cracking and disbonding at cold temperatures, and aid in preventing sagging at elevated temperatures.

The selection of a proper filler is not an easy matter because just any filler will not work. The filler should be relatively inactive with dilute acids, alkalies, salts, and in contact with soils. It should be relatively free of carbonates and show a low loss on ignition. In other words, minimum loss in weight occurs when heated. Most of the minerals used for fillers have a specific gravity of from 2.5 to 3.0, consequently the filler selected must show the least possible tendency to settle in the pitch at application temperatures. The fineness of the filler and the filler itself may affect the cracking temperature and the sag temperature of the enamel. Here are some examples: A ground silica filler was used putting in 25 per cent filler. The resulting product showed ash of sample taken from the top of the drum of coating as 12 per cent, and from the bottom of the drum 44 per cent. A slate filler was used that did not settle; however, the cracking point on the enamel was 45 F, instead of 25 F for the normal coating.

Normal fillers are purchased on the following specifications:

Screen analysis, 200 mesh 90 per cent.

Loss on ignition, not more than 10 per cent.

Maximum difference between top and bottom samples taken from enamel drum and ashed, 2 per cent maximum.

This specification covers only the supplier, for each new source of filler is closely checked for all the things mentioned above before acceptance.

Coal tar solvent. As stated before, the customary solvent used for primers has less than 5 per cent distilling below 150 C, and not less than 95 per cent distilling to 200 C, in other words, it is a closely cut fraction of the distillates from the coal in the coke ovens, and is recovered mainly at the coke plant along with the lower boiling solvents such as benzol, toluol, and xylol. The solvent is selected for its solvency or compatibility with the narrow range enamel pitches and its suitability for use in the production of the moderate and wide range enamel primers. Odor and evaporation time have much to do with the selection.

Three Coatings

Why three coatings? This question is in some respects difficult to answer. Yet in many applications each coating has its use.

Narrow range enamels: The narrow range enamel and primer was the first product placed on the market, and dates back probably to the latter part of the 19th century. Its use on oil and gas liners came into somewhat general use during 1920-1930 and was well established before the development and general introduction of the wide range enamels about 1930. By that time it was so well established and had proved itself so well adapted to oil and gas applications that the other enamels did not enter the picture to too great an extent until later.

The application of enamels to oil and gas transmission lines presents an entirely different set of conditions than any other application. For the most part the pipe is coated over the ditch or at the side, and the pipe is usually in the ditch and backfilled within two or three days. In addition, the coatings are usually applied during the spring, summer, and fall months when temperatures are above 32 F, thus avoiding cracking in cold weather. During the short time of exposure to summer heat and because of the usual use of felt, glass, or kraft wrapper there is little danger of flow or sagging of the coating because of heat. At temperatures below 30 F, however, the coating is subject to cracking and disbonding, for the coating cannot withstand low temperatures. The coating has certain characteristics that fit it admirably to oil and gas applications such as quick setting after application, high hardness, ease of application, no trouble to remove from the drums, easily broken up, easily melted and heated, and once in place in the trench, below the frost line and backfilled, gives excellent protection.

Wide range enamels. These enamels with their wide temperature range susceptibility of minus 20 F, cold without cracking and 160 F, heat without sagging were primarily developed for the water works industry where each pipe section is coated and lined at the fabricating plant or in a coating yard. These may be exposed to atmospheric temperatures given above for days, weeks, or months. It is essential that the coating stand the cold of winter without cracking, and the summer heat without flowing or sagging from the pipe. The fact that this grade of coating can stand such conditions makes it suitable for those applications in early spring, late fall, or winter months when lines must be coated and installed in such weather. Again the coating has sufficient hardness and also flexibility at ground temperatures below the frost line to resist puncture by stones and various things in the backfill, resist soil stress, and is just as capable of giving lasting service to the oil and gas lines as the narrow range enamels.

It does have some disadvantages. Because it is flexible, ductile, and a somewhat softer coating, it is very soft at summer temperatures. In the hot sun where pipe temperatures in the middle of the day may reach 160

F the coating may flatten out where the pipe lies on the skids, so much so that holidays may result at these spots. Despite this, a large amount of this coating has and is being used quite successfully.

Moderate range coatings. For several years moderate amounts of this grade enamel have been used mainly in coating plants where the pipe is primed and coated in short sections and shipped to the job site. Some has been used in field applications but not to too great an extent until the last two years. This coating will withstand zero temperatures without cracking and to 140 F without sagging. This coating is only slightly softer than narrow range enamel, much harder than the wide range so that for summer application it eliminates the major difficulties of the wide range enamel and will withstand the lower temperatures that destroy the narrow range enamel. It comes more nearly being an all weather coating and fills a definite need in the oil and gas industry.

Specifications and Tests

Specifications and laboratory tests; what do they mean?

Specifications are for the guidance of both the customer and the manufacturer to insure a uniform product that will meet the requirements of the customer. If the customer selects the material that is suited to the job he has to do, then the specification is the guide to the manufacturer to manufacture the suitable material.

The specifications given below are wider limits than normal as they are made to include the products of all manufacturers. Perhaps a description of the meaning of the various points as related to the coatings will give a better understanding of the specifications.

Specific gravity. Specific gravity is the weight of a unit volume of the material at a prescribed temperature compared to the weight of the same unit volume of water at the same or a prescribed temperature; thus the specific gravity times 8.33 gives the weight per gallon of the product or specific gravity times 62.32 gives the weight per cubic foot. This in turn gives the applicator the coverage he can expect based upon the average thickness of application. To the experienced coating technician the specific gravity gives him some indication as to whether or not the coating is an all coal tar product or might contain some foreign materials.

Softening point. Softening point of bituminous products is an empirical test that might be termed a measure of flow of the material. Pitches and pitch products do not have a melting point. The test as set up in ASTM is a specific procedure such that if two separate operators testing the same product follow the procedure exactly as described they will obtain identical results within the range of experimental error.

Narrow range enamel is hard and brittle at ordinary temperatures. If a piece of it is left standing in a room at normal temperatures for a long time, however, the piece loses shape and flattens out. This is cold flow.

The softening point is somewhat a measure of this cold flow. The higher the softening point, the less the cold flow. Softening point also gives us a gage as to the application temperature of the coating. In general, add 225 F to the softening point of the coating and the resulting temperature is the approximate application temperature.

With the moderate and wide range enamels the softening point does not measure the cold flow because these coatings do not exhibit very much cold flow at ordinary temperatures.

Penetration. Penetrations are an arbitrary selection of a certain size needle, a set of specific weights and selected time and temperature for conducting the test. The needle, its holder with additional weight supported on the shoulder of the holder, make up the total weight specified for the test. The needle is supported in a vertical position above the coating with the tip of the needle in contact with, but not pressing against, the coating. The needle, holder, and weight are released for the specified time so that the total weight is pressing the needle into the coating for that period of time. Penetration is the depth that the needle penetrates into the coating reported in tenths of a millimeter. As with softening point, two operators following directions to the letter will get the same results.

With the narrow range type coatings, penetration is a measure of the softening point and cold flow. In other words, a table could be made up for these enamels whereby the softening point would be known simply by determining the penetration, or the reverse.

Penetration on the moderate and wide range coatings is entirely different since they exhibit less cold flow. In this case, the penetration becomes a definite measure of the hardness of the coating at the temperatures at which the tests are conducted, and gives a measure of the flexibility of the coating. The relationship between the penetrations at 77 F and at 115 F, in conjunction with the softening point of wide range enamel, tell whether or not the coating will sag at 160 F, and whether or not the coating will crack at low temperatures. Experience has shown that to meet both the high temperature sag test and the low temperature cracking test on wide range enamels, the penetration at 115 F must be not more than slightly over double the penetration at 77 F. That is, if the penetration at 77 F, 100 g., 5 sec is 10, then the penetration at 115 F, 50 g., 5 sec should not be more than 25. At the same time, the softening point must not be below 220 F. The greater the ratio between the penetrations, the lower the sag point and the higher the cold test point. This is true for penetrations at 77 F of 8 or above. Below 8 penetration at 77 F. the readings are somewhat false and the ratio approaches 1:3.

TABLE 2. Specifications.

	Narrow range		Moderate range		Wide range	
Primer	Min.	Max.	Min.	Max.	Min.	Max.
Specific gravity 25 C	1.120	1.160	1.110	1.160	1.110	1.160
Viscosity: Stormer; 100 g.wt; cylinder; 77 F, sec	45	75	45	75	45	75
Distillation: ASTM distillate to 235 C	30%	50%	30%	50%	30%	50%
Drying time: 300—600 sq ft per gal application rate: 77 F at 50 per cent humidity						
Dry to touch		1		3		3
Dry for bonding enamel		4		8		8
Enamel						
Specific gravity 25 C	1.40	1.55	1.40	1.50	1.40	1.50
Softening point ASTM D-36-26 F	180	200	180	200	220	
Penetration ASTM, D-5-25						
100 g., 5 sec, 77 F	0	2	2	6	7	20
50 g., 5 sec, 115 F	0	8	10	30	14	50
Ash, mineral filler residue on ignition ASTM D271-37%	15	35	15	30	20	35
Sag Test: 3/16 in. coating on 12 in. by 12 in. by 7/16 in. steel plate, in oven at prescribed temperature, vertical						
5 hr at 120 F		1/2 in.				
5 hr at 130 F				1/2 in.		
24 hr at 160 F						1/2 in.
Cold test: Run on plates after sag test						
5 hr at 30 F	no cracking or disbonding					
5 hr at 0 F			no cracking or disbonding			
5 hr at —20 F					no cracking or disbonding	
Stripping test: Peel test 3/16 in. by coating on 1/2 in. by 12 in. by 12 in. steel plate tested after pouring and at each 20 F increment up to sag test temperature 1 hr at each temperature	1/8 in. max. to 120 F		1/8 in. max to 130 F		1/8 in. max. to 160 F	

Built to Cut Maintenance

EASIER MAINTENANCE PROCEDURES and lower maintenance costs are important features of this brand new line of large motors. One man can perform all routine maintenance procedures, including opening up the motor for cleaning. Bearing surfaces are not exposed to abrasive grit and dirt during cleaning operations.

The appearance of this new line of large motors reflects the advanced design and fine workmanship that goes into their manufacture.

A well-braced, sturdy fabricated steel frame with cast-iron end brackets rigidly support and protect working parts. Ventilating openings are large to provide adequate cooling air at low velocities with resultant low sound level.

Wide Range of Sizes

These new design Allis-Chalmers drip-proof and splash-proof squirrel-cage induction motors are built in sizes from 60 hp at 300 rpm to 1500 hp at 1800 rpm. Ask your Allis-Chalmers representative to show you the details of this exceptional new motor or write for Bulletin 05R7542.

How's This for Accessibility

One man can remove the end brackets and air baffles and reach right inside motor with his vacuum cleaner or air hose. Bearing remains sealed against abrasive dirt throughout the cleaning operation.

Large air discharge openings with removable louvers allow plenty of room to get in with an electric drill for doweling and bolting the motor to the base. Plenty of room to reach up back of the stator core for cleaning.

A-3179

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Ash, mineral filler. This determination tells how much filler is in the coating, but may be very misleading concerning the true amount of filler in the coating. The ash determination is carried out at about 900 C, which means that many fillers such as carbonates will break down in the heat. This loss may be as high 30 to 40 per cent. Thus, an ash determination might show 25 per cent ash and yet the actual amount of filler could be as much as 42 per cent. Thus, it is up to the manufacturer to select a filler with as low a loss on ignition as possible in order to produce a satistactory coating. The addition of a high loss on ignition filler might throw the actual percentage of filler so high that the coating would not flow at application temperatures.

Sag test. The sag test describes itself; it is a means of determining whether the coating can withstand high summer temperatures without sagging or running from the surfaces on which it is applied. Sag test in conjunction with the moderate and wide range coatings is also a measure of the quality of the primer. Even though the coating may be perfect, if the primer is not good and is not suitable to the coating, it will permit the coating to slide over its surface and make the coating appear bad. Applied coatings exposed to summer temperatures and sunlight only reach maximum temperatures for about 5 hr during the day, but this temperature may be as high at 160 F because of the light and heat absorption of the black surfaces.

Cold test. Cold tests tell to what low temperature the coating may be subjected and still not crack or disbond from the metal. The test is usually determined on the same plate that is used for sag test so that if any changes in the coating have been brought about due to heat they will show up in the cold test. In this test, as in the sag test, the determination is also a measure of the quality of the primer. A poor primer may permit the coating to disbond from the metal without cracking. The coating can take the low temperature, but the primer cannot. Cold test must not be confused with the temperature at which a coating can be handled at low temperatures. A wide range enamel cannot be flexed at 20 F.

Stripping test. The stripping test is a measure of the quality of the primer. It is carried out on heavy steel plates in order to overcome the effect of heat transmitted to the plate from the hot coating when it is poured over the plate. If a thin plate is used in the test, sufficient heat may be transmitted to the plate to give a bond regardless of the primer. In fact, at the beginning of the work on wide range coatings, specifications called for the stripping tests to be run on thin plates. It was found that the coatings gave no stripping but when applied in the field had no bond whatever.

These are the tests outlined in the specifications at the beginning. There are other tests that are used and are discussed below.

Direct impact. The plates from the sag test and the cold test are brought to room temperature (77 F) then supported on a block of wood 2 in. by 12 in. by 12 in. and a steel ball weighing 650 g. is dropped onto the surface of the coating from a height of 8 ft. This results in an indentation at the point where the ball strikes, radial cracks out from this central point, and a consequent disbonding of the coating around the area. The length of the radial cracks are measured, then the disbonded coating removed and the total area disbonded is measured.

The results of the test are a measure of the punishment from blows and knocks that the coating can stand. In a sense, it is also a measure of the quality of the enamel and of the primer. With poor primers, large areas are disbonded.

Indirect impact. The same plate used for direct impact is used in making the indirect test. The plate is coated and turned face down over a 3-in. hole in the wooden block. The steel ball is dropped from the same height onto the metal directly over the hole in the wooden block. The impact in this case dents the plate and causes, usually, short radial cracks out from the point of impact. Normally no enamel is disbonded. This test also indicates the ability of the coating to stand abuse and also indicates a poor primer if much of the coating is disbonded.

Cold bend. The cold bend test is supposed to indicate the ability of the coating to withstand flexing or handling. A coated steel plate is bent over a mandrel at a specified temperature and through a specified arc. The coating will crack and some will disbond. The test is not too informative.

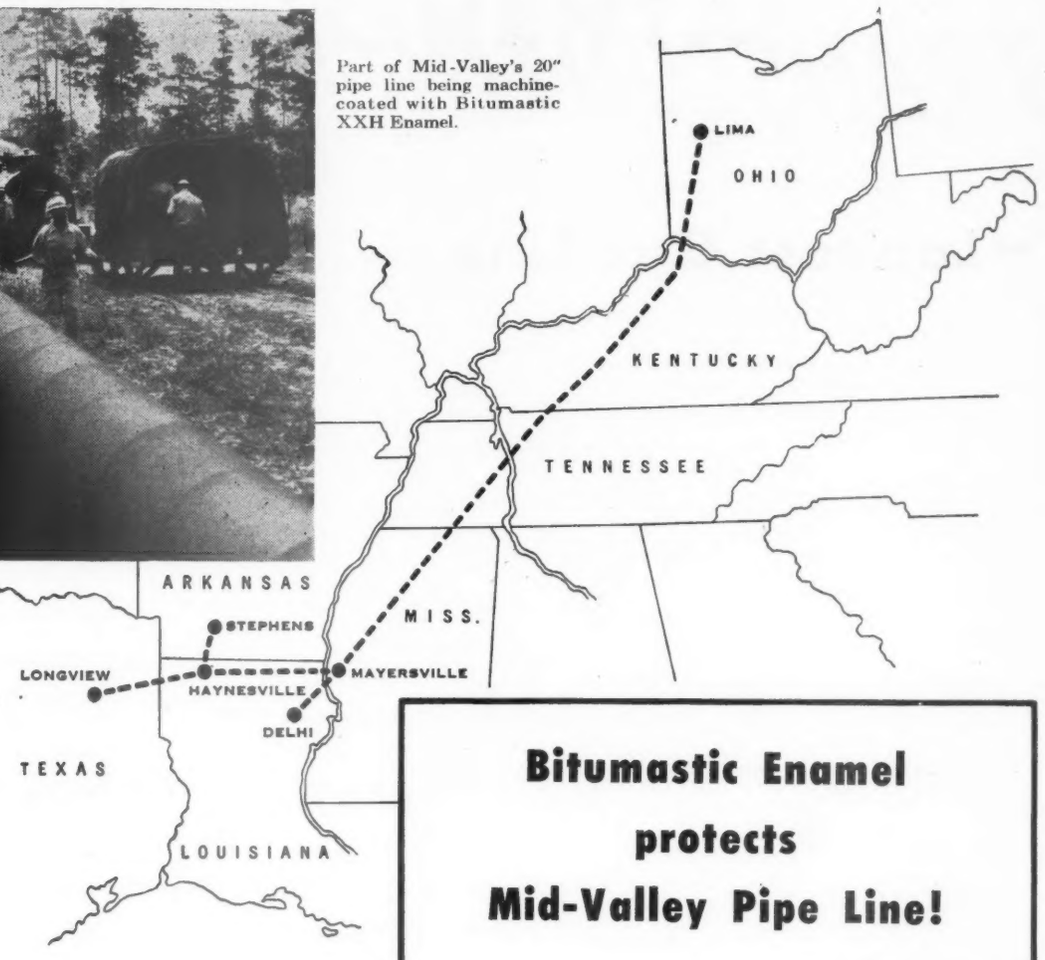
This test is usually carried out by coating plates immediately after the coating is at application temperature, then a second set of plates poured after the coating has been held at application temperature for 2 hr. This is to give an indication of whether the coating changes much when held at application temperature for a period of time.

Part 2 will be published soon.

Coated and wrapped, a long stretch of 26-in. pipe awaits lowering.

—Courtesy H. C. Price Company

Part of Mid-Valley's 20" pipe line being machine-coated with Bitumastic XXH Enamel.



Route of the 1,000-mile Mid-Valley crude oil pipe line. It will stretch from Longview, Texas, to Lima, Ohio. More than 2 million bbls. of oil will be needed to fill this line.

Bitumastic Enamel protects Mid-Valley Pipe Line!

...ONE OF THE COUNTRY'S LARGEST AND LONGEST INTERSTATE COMMON CARRIER CRUDE LINES

THE Mid-Valley Pipe Line, that will stretch from Longview, Texas, to Lima, Ohio, will be an outstanding example of the engineering skill and ingenuity of pipeliners. Along the thousand-mile route, swamps, lakes and rivers, including the Ohio and the Mississippi, had to be "ditched" . . . rocky hills had to be crossed . . . forests had to be penetrated.

When pipe lines are laid under such rugged conditions, they *must* go down to stay . . . they *must* be fully protected against corrosion. And Koppers Coatings provide that protection.

Koppers Bitumastic® XXH Enamel was used to coat the line from Texas to Tennessee. In addition, three gathering lines have been protected by Bitumastic XXH Enamel.

Give *your* pipe lines the same effective protection by specifying "Koppers Bitumastic Enamel." Your Koppers representative will give you full details. Get in touch with him.

Why Bitumastic Enamels give lasting protection

Processed from a base of coal-tar pitch, they are impervious to moisture . . . chemically resistant to soil elements. They make a tight bond with the pipe . . . do not disintegrate with age . . . maintain continuously high electrical resistance.

KOPPERS BITUMASTIC ENAMELS
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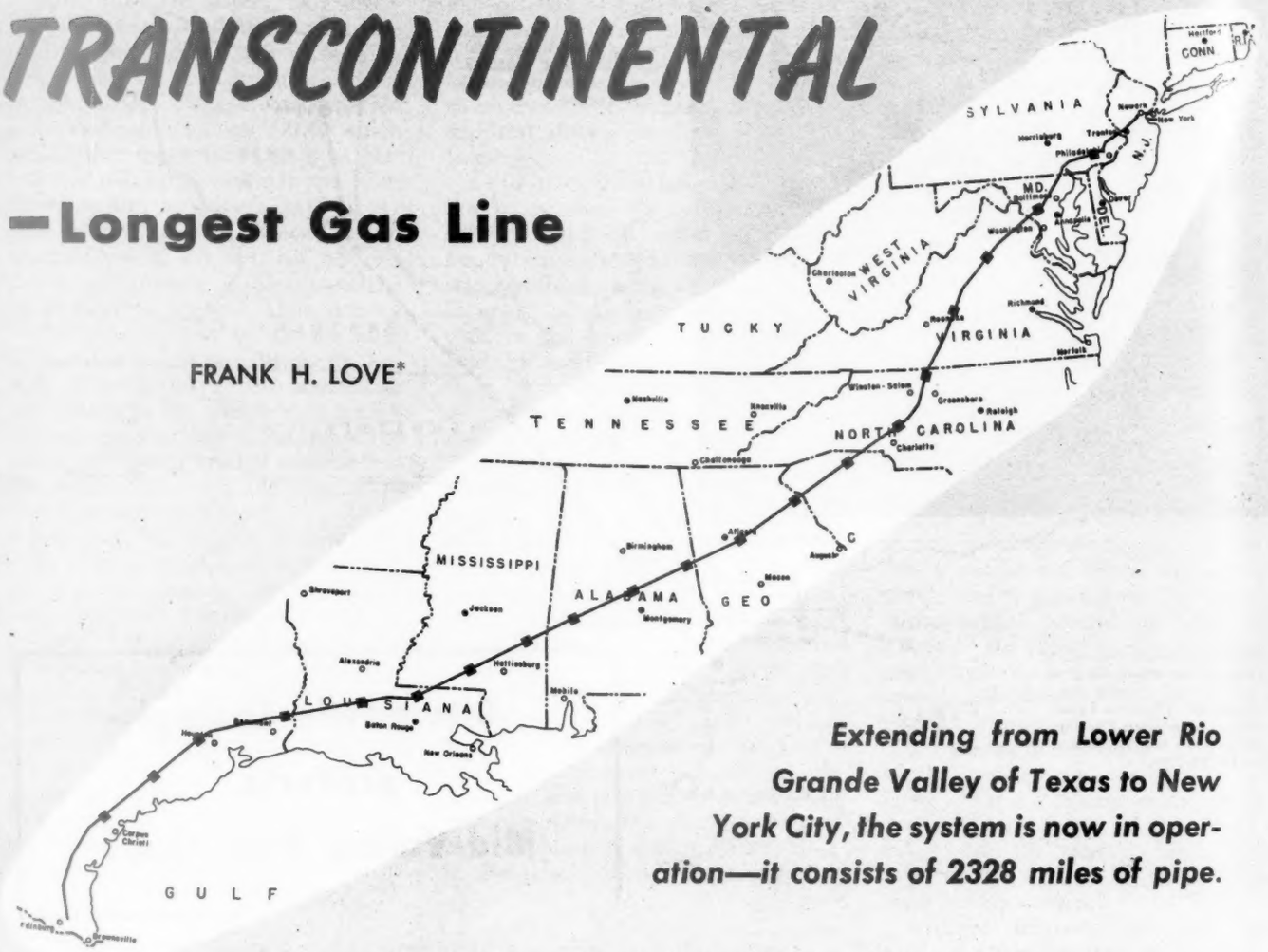
KOPPERS COMPANY, INC., Tar Products Division, Dept. 251T, Pittsburgh 19, Pa.

TRANSCONTINENTAL

—Longest Gas Line

FRANK H. LOVE*



Extending from Lower Rio Grande Valley of Texas to New York City, the system is now in operation—it consists of 2328 miles of pipe.

THE world's longest cross-country gas pipe line is now in operation.

Extending from the Lower Rio Grande Valley of Texas to New York City, Transcontinental Gas Pipe Line Corporation's system was placed in service early this year. As presently designed and built this $240,000,000 project has a capacity of 505,000,000 cu ft a day at an operating pressure of 800 psi to supply gas needs to eastern users and consumers along the way.

The undertaking has required less than two years to complete, which is remarkable in light of its scope. Actual construction work, as a matter of fact, was considerably less than two years, the ground breaking ceremonies having been held at Laurel, Mississippi, on May 23, 1949. Right-of-way procurement had been underway since the previous February.

The extent of the project, quite naturally, gave rise to a number of interesting statistics:

Pipe mileage totaled 2328.18, consisting of 1832.34 miles of main line, 383.10 miles of gatherings lines, and 112.64 miles of sales laterals. The main line is of 30-in. diam pipe.

To make this volume of pipe required 510,000 tons of steel.

Right-of-way procurement involved 10,000 individual pieces of property.

There were 36 major underwater crossings, and four suspension bridges.

Highway and railroad crossings totaled 620.

There were 18 general pipe line contractors, believed to be the greatest number ever to be engaged on a single project of this kind. In addition, there were numerous sub-contractors and specials contractors for stringing, double-jointing, etc.

Gas supply is from 34 fields along the Texas-Louisiana Gulf Coast, an area with proved reserves of 50 trillion cu ft of gas.

These are some of the outstanding factors involved in an undertaking that, because of the vast territory covered, resulted in many construction problems and introduced some new methods, which will be discussed subsequently.

First, however, it might be well to review briefly the history of Transcontinental. Trans-Continental Gas Pipe Line Company was formed early in 1946 by Claude A. Williams (president of the present company) and Rogers Lacy, for the purpose of negotiating for purchase of the War Emergency Pipelines (Big Inch and Little Big Inch) and, should they be unsuccessful in that direction, to build a gas line from Texas to the East Coast. Williams and Lacy owned all the original stock, but eventually it was decided to admit other stockholders. Prior to financing, however, Transcontinental Gas Pipe Line Corporation (a Delaware corporation) acquired the assets of Trans-Continental Gas Pipe Line Company (a Texas corporation). Ray C. Fish, Clyde H. Alexander, and others came into the picture as stockholders. The company was unsuccessful in obtaining the War Emergency Pipelines, which went to Texas Eastern Transmission

*Editor, Oil and Gas Pipelining.

EXCLUSIVE

TRANSCONTINENTAL

SPECIFIES SOMASTIC*

Somastic-coated 26-inch pipe, prepared for Hudson River crossing.

Time-tested Somastic protection—the right answer to severely corrosive conditions.

To the management, engineers and agents of Transcontinental Gas Pipe Line Company, we offer our sincere congratulations for a job well done.

We are proud that you specified SOMASTIC Pipe Coating as a means of permanent pipe protection on the eastern portions of your project, particularly at major river crossings and heavily congested areas where corrosion problems and stray currents are acute.

***SOMASTIC**

*Reg. U. S. Patent Office

PIPE COATING

The dense, compact, uniform and seamless protective coating—*unequaled for PERMANENT PROTECTION*

H. C. PRICE CO.
SOMASTIC DIVISION
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OKLAHOMA

GULF DIVISION
P. O. Box 263
Harvey, La.

EASTERN DIVISION
P. O. Box 6120
Philadelphia, Pa.

Shooting ditch in rocky area.

Ditching machine finds "going" easy in this type soil.

Testing a weld with X-ray equipment.

Corporation. This was in 1947. Previously, in May, 1946, application had been made to the Federal Power Commission for permission to lay a line from Texas to the East Coast. When the WEP lines were sold to Texas Eastern, plans for the Texas-to-New York City line were pressed with vigor. At a hearing before FPC in October, 1947, time extensions were asked so that revised supply and sales contracts could be negotiated. In May, 1948, FPC issued a conditional certificate subject to the company procuring pipe and completing financing. With these matters successfully consummated, contracts were let December 3, 1948, for construction of 605 miles of 30-in. between Eunice, Louisiana, and Danielson, Georgia. This work, and construction of five compressor stations, was to be done in 1949. The remainder of the line and two additional stations were completed in 1950 and are in operation. During 1950, also, the final 12 stations were under construction and will be on the line early in 1951, making a total of 19 stations for the system.

Across the State of Maryland

From the east bank of the Potomac River to the west bank of the Susquehanna River, ASSOCIATED laid Transcontinental's 30" pipeline . . . proof again of ability to successfully and satisfactorily construct lines of any size and length.

ASSOCIATED

PIPE LINE CONTRACTORS, INC.

A. L. FORBES, Jr., President EARL ALLEN, Vice-President
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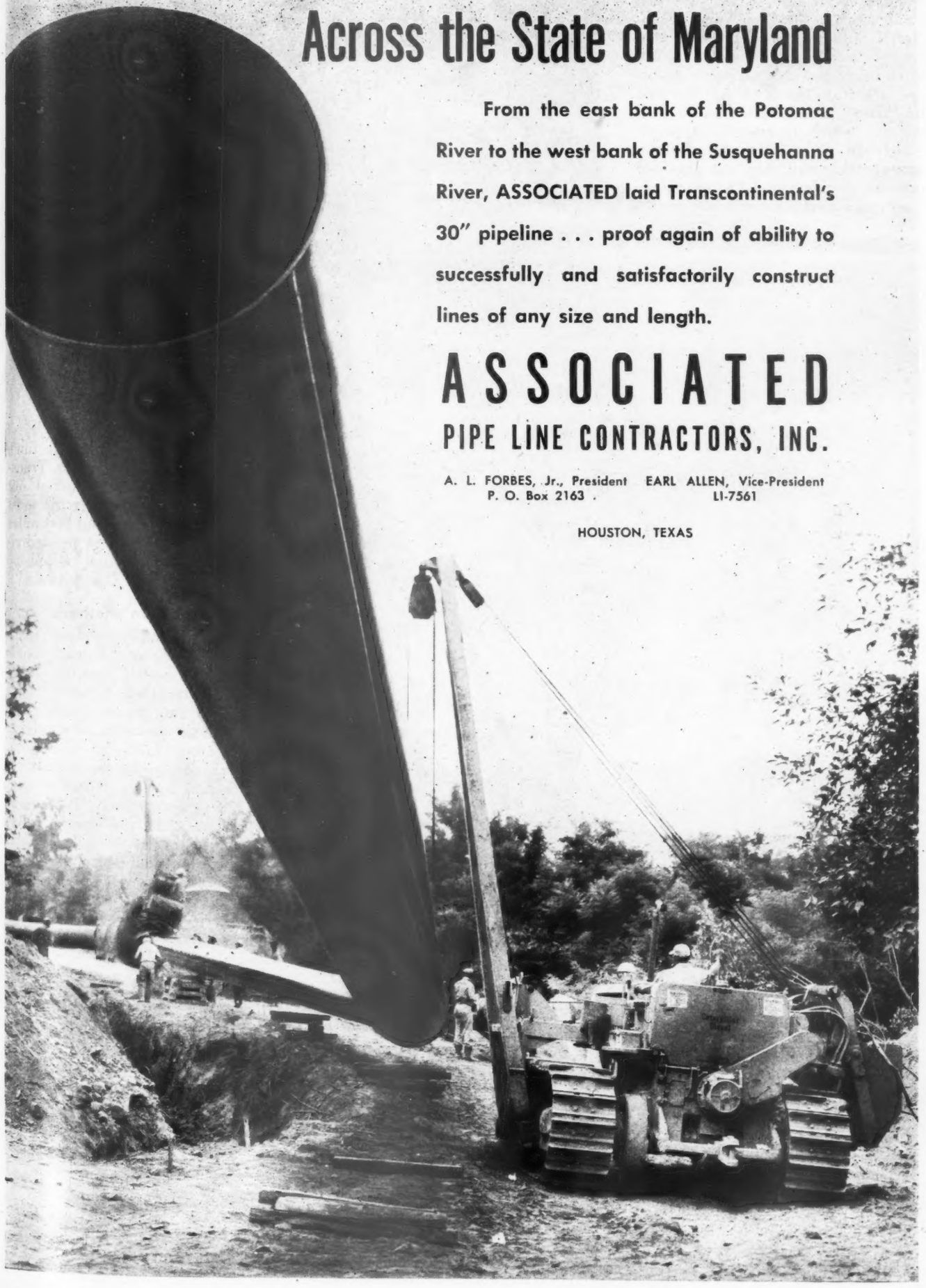
HOUSTON, TEXAS

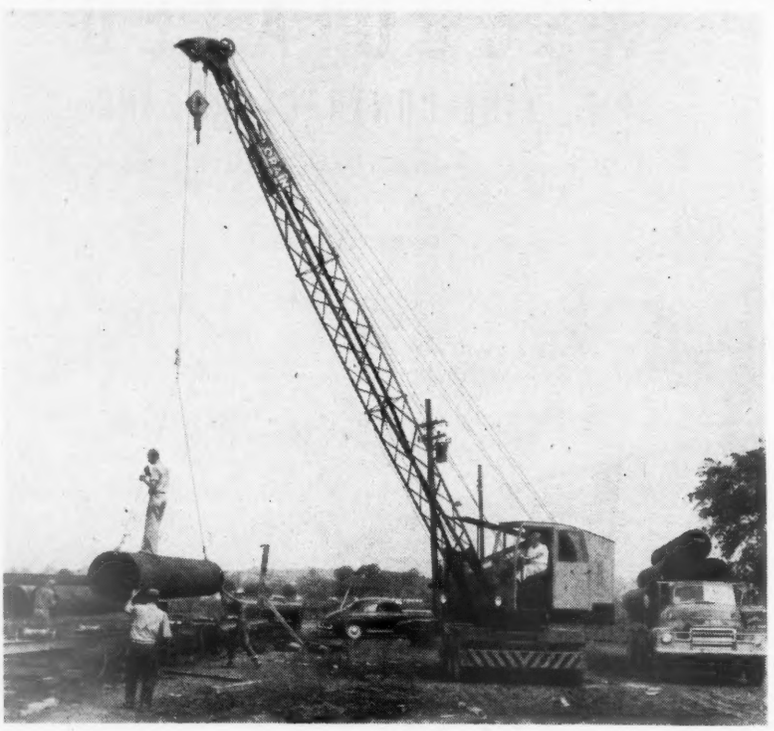


Aerial Mapping

Prior to the beginning of construction an aerial map of the proposed route was provided by Edgar Tobin Aerial Surveys. Supplied was a controlled aerial photographic mosaic three miles in width, taking in a mile and a half each side of the proposed line. These photographs were in 10-ft lengths, which represented approximately 20 linear miles. In addition, an ownership strip map was provided covering the same area. The ownership map was a film positive transparency to overlay the aerial photographs.

It is interesting to note that much of this mapping could be done from Tobin's library consisting of 500,000 square miles of aerial photographs and 268,260 sq miles of ownership maps. For example, in two days' time, at the beginning of the project, Transcontinental officials had worked out with the mapping company the most desirable route for the first 850 miles of the line and also knew the individual tracts of land that would be traversed.

Pipe being strung along right-of-way prior to ditching.



Crane handling pipe in a double-jointing yard.

Construction Methods

As would be anticipated in laying a pipe line whose total mileage would reach approximately two-thirds the way across the United States, many types of terrain were crossed, and many natural obstacles encountered, the numerous problems taxing the engineering ingenuity of the builders. Swamps and bayous in gulf coastal region between Houston, Texas, and Eunice, Louisiana, and again between the Mississippi River and Georgia, constituted one of the principal problems. Mountains were largely avoided, which was a great help. Forty major rivers were crossed, however, as well as many minor ones, and each of these required a special engineering study to determine what was the best type of crossing to make in view of local conditions.

General specifications required that the right-of-way be cut to width of 75 ft except in wooded areas where a 50-ft right-of way was permissible. Cover for the 30-in. pipe normally was 30-in. minimum, with 24-in. cover al-

Applying hot coal-tar enamel and glass-mat wrapper to pipe on South Texas spread.

VERTICAL SMOOTH PIPE BENDER

PROVED FAST ECONOMICAL *ON ALL SIZE PIPE LINES*

FAST— Pipe is placed in machine from either end and bent vertically. Bend easily measured with protractor; for additional bends, set measuring chain and bend to it. Bends are accurate to within ¼ degree. Machine can be moved quickly along line.

ECONOMICAL— Inexperienced operators can quickly learn operation of simple controls; low maintenance because of rugged construction; dependable and adequate power. Minimum of right-of-way required . . . 20-25 feet for both bender and tractor handling pipe; mounted on 18" Athey tracks. Powered by U-6 International Engine. Can be transported on standard truck float.

FINDINGS OF TESTING LABORATORY ON PIPE BENT WITH THIS MACHINE AVAILABLE.

18 YEARS PIPE LINE CONSTRUCTION EXPERIENCE.

CRUTCHER • ROLFS • CUMMINGS, INC.

Pipe Line Equipment and Supplies

HOUSTON, TEXAS — TULSA, OKLAHOMA

lowed in rocky terrain. Width of the ditch was 42 in. In some instances rock shields were used instead of dirt padding to protect coatings in rocky terrain, the discretion of the contractor prevailing.

The line was all-welded, with No. 5 Fleetwood electrode used for the stringer bead, No. 85 for the filler, and No. 5 for the cap. Welds were tested both visually and by sampling with X-ray equipment. At river crossings all welds were X-rayed. This procedure was also followed in the entire area near the Hudson River. Either smooth or wrinkle bends were permitted, the contractor being allowed his option.

Hot coal-tar enamel and glass-mat wrapper were applied following cleaning and priming. At river crossings the pipe was given a double coating and wrapped with asbestos felt in addition to the glass-mat. In swampy areas, concrete-encased pipe was used to give both weight and protection.

Running of a holiday detector behind the dope gang and lowering-in crew was specified. Usually two detectors were used, one immediately behind the dope and the other just ahead of the lowering-in gang.

In rough country both supported and unsupported type spans were used. Unsupported spans of 30-in. pipe were restricted to a maximum length of 85 ft. It was stipulated also that the spans should have a minimum clearance of 10 ft. Canals, major drainage ditches, gulleys, and ravines are examples of the instances where spans were used.

Line pipe used in the system has four wall thicknesses. The pipe used most extensively has a 0.3125-in. wall. Pipe installed on the discharge side of stations for a distance of 20 miles has a wall thickness of 0.325 in. At all highway and railroad crossings, and for a minimum distance of 2000 ft across each compressor station location, thickness is 0.375 in. For single lines across rivers, the pipe has a 0.500-in. wall. Additionally, pipe laid in hazardous locations has a wall thickness of 0.375 in. and 0.325 in.

Plate used for making the pipe was required to have a minimum yield

Top—Cleaning and priming pipe prior to coating and wrapping.

Center—Bending pipe to make it fit the contour of the ground.

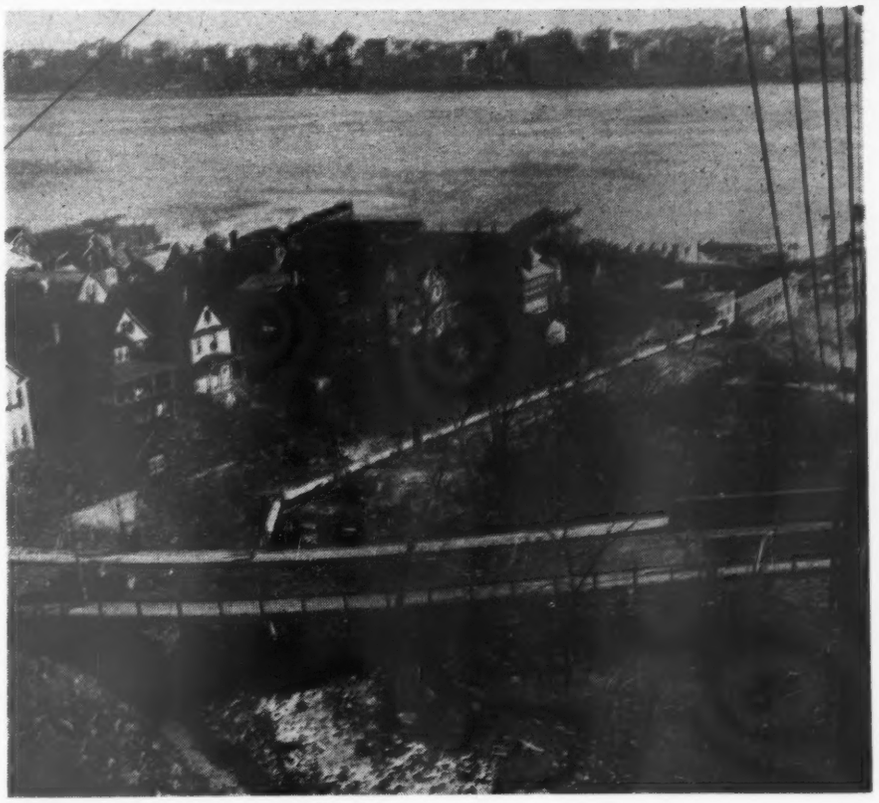
Left—River crossing pipe with clamps and slats in place being walked-in.

point of 42,000 psi. Ultimate tensile strength of the expanded pipe was 72,000 psi. Minimum yield point for pipe including that with ⅜-in. wall thickness was 52,000 psi; for ½-in. pipe, 46,000 psi.

Double-Jointing

Many pipe line construction jobs are routine in nature, the methods employed the same as those used on numerous others. Quite often, however, a new procedure is evolved. On the Transcontinental project double-jointing came into existence. Because the pipe joints were only 30 ft in length, it was thought that greater speed in the field would be attained if two joints were welded together before stringing the pipe. The method was tried out on a limited scale during the 1949 construction, but proved its worth to such a degree that it was universally adopted for 1950. The double-jointing was done either by the submerged automatic arc-welding process in a yard, or manually on the right-of-way.

Procedure for yard automatic arc-welding was for the stringer bead to be run manually. Upon this and the proper preparation of the pipe ends depends whether the automatic weld will be successful. After the stringing bead was cleaned, the finish weld was made automatically in a rolling rig specially designed for this work. Many advantages accrued to the practice. In the first place, laying was accelerated as a 60-ft joint of pipe could be handled about as fast as a 30-ft one. More welds could be made in a day's time, which reduced welding costs, and in addition the welds were more uniform. Pipe bending was made easier, and stringing was facilitated as fewer pieces of pipe had to be handled.



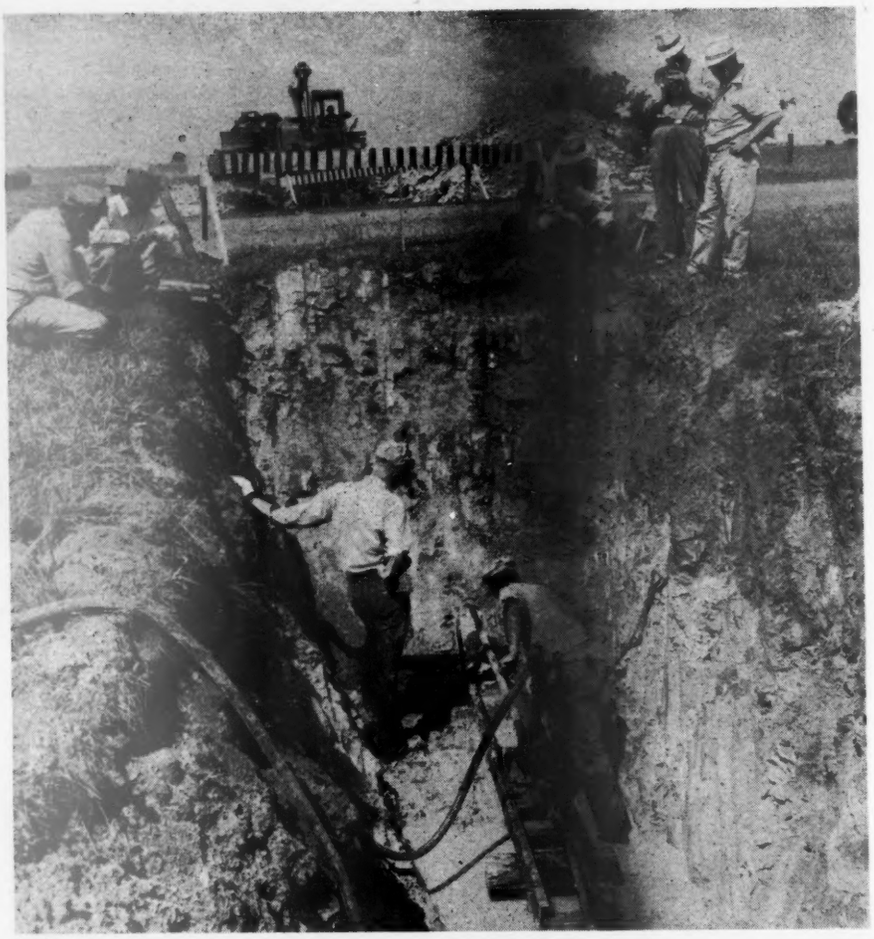
Top—An unusual welding scene.

Center—View of line at Edgewater, New Jersey, as it extends up from Hudson River and starts across Palisades toward the Jersey meadows.

Below—The main line ditch was 42 in. wide and normally pipe was given a 30-in. covering.

River Crossings

River crossings played an important part in this project. Of the 40 major streams crossed, four were by means of suspension bridges, 9 with multiple lines, and 27 with single lines. Suspension bridges have been completed across the Brazos and Colorado Rivers in Texas and the Coosa River in Alabama. The Atchafalaya

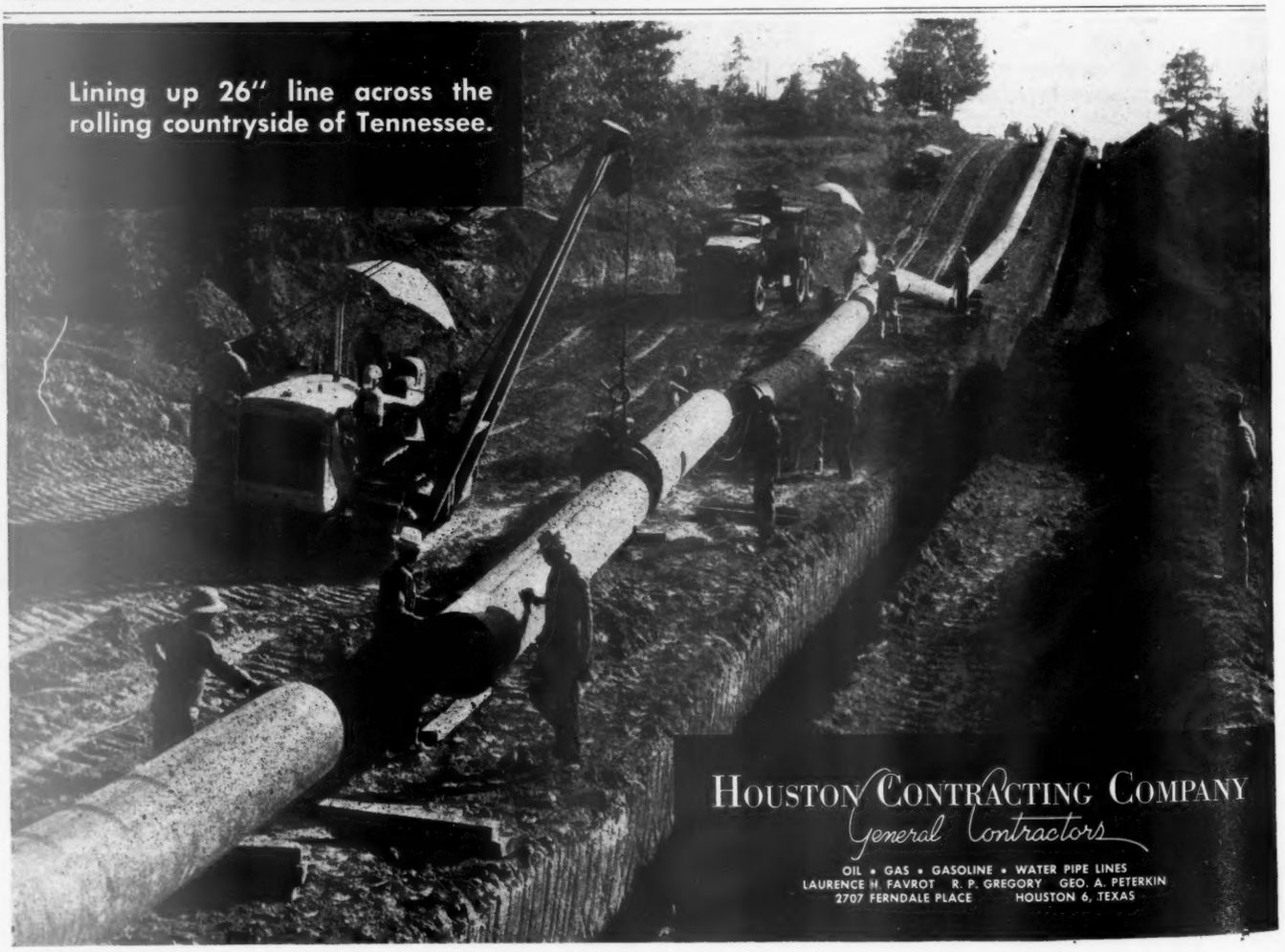


Boring a highway crossing. There were 620 highway and railroad crossings made.

River in Louisiana is still under construction; however, three 12-in. lines were installed for use while the bridge is being finished. Dual 24-in. underwater lines have been laid across the Mississippi, James, Trinity, Sabine, Savannah, Potomac, Susquehanna, Delaware, and Raritan rivers. All 24-in. river pipe has a wall thickness of 0.937 in. In the case of the Hudson, where a single 26-in. line was laid, the wall thickness is 1.125. At the Hackensack and Passaic Rivers, where 26-in. single lines were also installed, the pipe has a wall thickness of 1 in.

Excessive water depth, unstable bottoms, and steep high banks were the factors that determined the installation of suspension bridges across the four rivers named. Multiple underwater crossings were made when the length of the crossing was especially long, where the current was swift and a break might occur, or near a market area where a line break would shut off supply.

The Atchafalaya River bridge, when completed, will be the longest pipe line suspension bridge in a gas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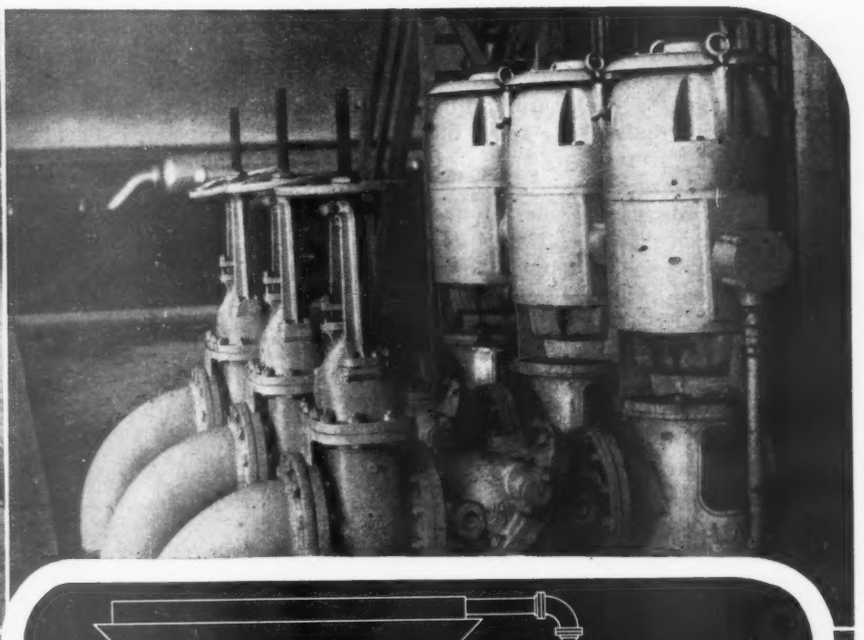

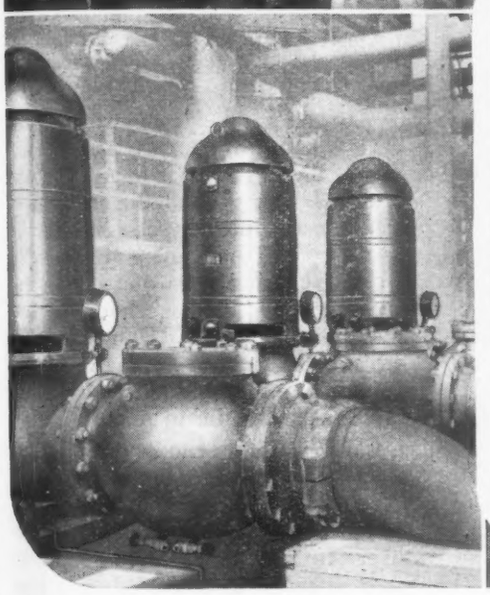

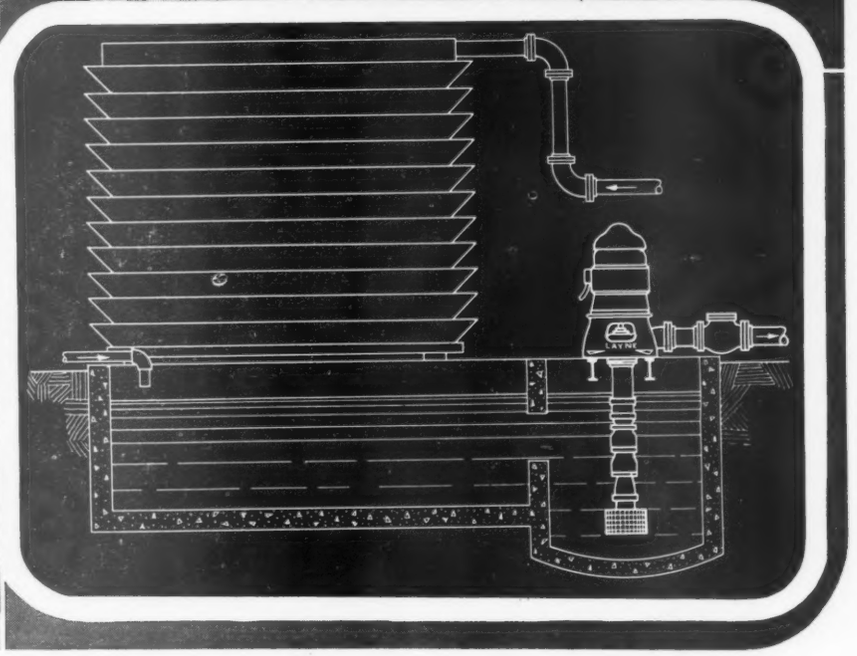

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transmission system in the United States. It will have a main span of 2000 ft and an overall length of 3650 ft. In addition to being wide, this river is exceptionally deep, about 50 ft, and swift. Furthermore, the river is subject to severe scouring action.

Several factors have made this installation a difficult job and have delayed its completion. For one thing, there is no solid foundation until a depth of about 130 ft below river bottom is reached. Consequently, it was necessary to install caissons at a considerable depth. To obtain proper clearance for installation of the caisson on the west side of the river a portion of the levee had to be relocated, and to do this a part of a state highway that parallels the levee also had to be re-located. Then, as the river is navigable, the pipe had to be carried extra high to allow ships to clear.

The Coosa, Brazos, and Colorado bridges presented no particular difficulties. They all are shorter than the Atchafalaya. The Coosa has a main span length of 700 ft and an overall length of 1100 ft; the Brazos a main span length of 750 ft and overall length of 1416 ft, and the Colorado a main span of 550 ft and overall length of 1180 ft. All suspension bridges have been designed to support ultimately two 30-in. lines.

The bridge across the Brazos River is at a point about 11 miles northwest of Rosenberg, Texas, and consists of a single span of 750 ft. It carries a 30-in. OD line at present, but is designed to carry two such lines, and it is expected that a second line will be added at a later date. The second line will be supported in supplementary castings directly below the original line. All foundations, consisting of the two main piers and the two concrete anchorages, are founded in steel bearing piles. The main towers have an overall height slightly in excess of 100 ft and the superstructure of the bridge is supported by two main cables each 2¾ in. in diam.

The bridge across the Colorado River is at a point near Glenflora, Texas, and consists of a single span of 550 ft. It carries a single 30-in. OD line at present, the same as the Brazos bridge, and in this case also a second line of the same size is expected to be installed later, supported in supplementary castings directly below the first. The two main piers are founded on steel bearing piles, but it was not necessary to use piles under the two concrete anchorages. The main towers are approximately 90 ft high. The superstructure is supported on two main cables each 2⅜ in. in diam.

Construction of the auxiliary 3-line crossing of the Atchafalaya River River called for special engineering because of the scouring action of the river. In fact, this is said to be the most difficult river crossed by a pipe line. These lines were laid 50 ft apart and with a bend on the east side laid on pipe stringers. As the bottom scours and the river deepens the lines, by reason of the bends, can sink and maintain their position on the river bottom.

In the case of most river crossings, the trench was dredged and the pipe pulled or walked into place. The Hudson and Mississippi Rivers were exceptions, they were jetted with air and water.

Some of the crossings required only routine construction methods. Others were taken out of this category by reason of individual characteristics. The Hackensack and Passaic, for example, had to be deep ship channel crossings because of heavy traffic on them. In both instances the pipe was buried 10 ft deeper than required by U. S. Army Engineers. The bottoms of the Potomac and Susquehanna were of solid rock, which had to be shot, and, in addition, there

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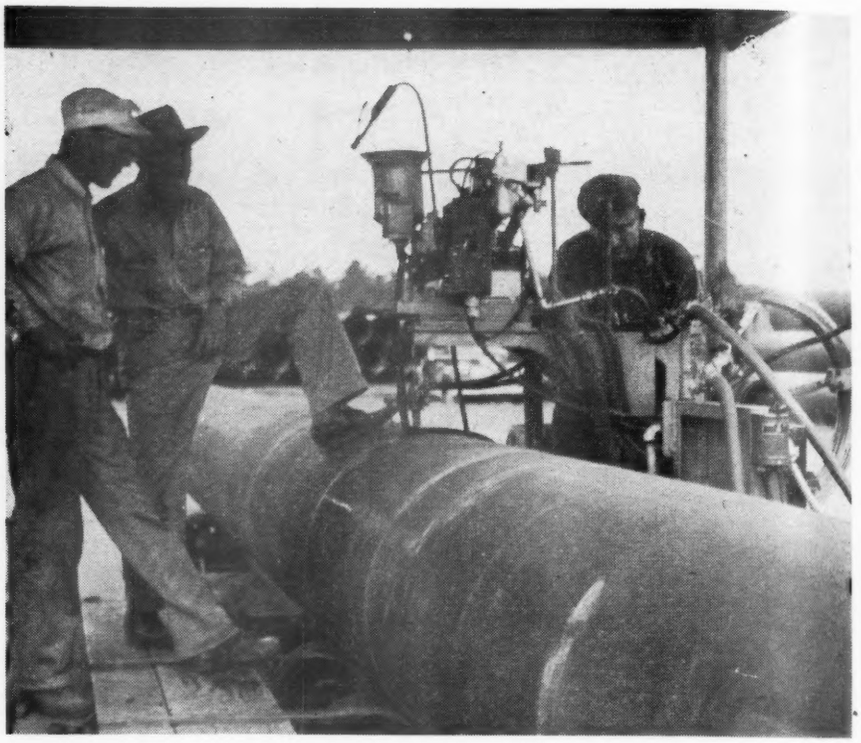
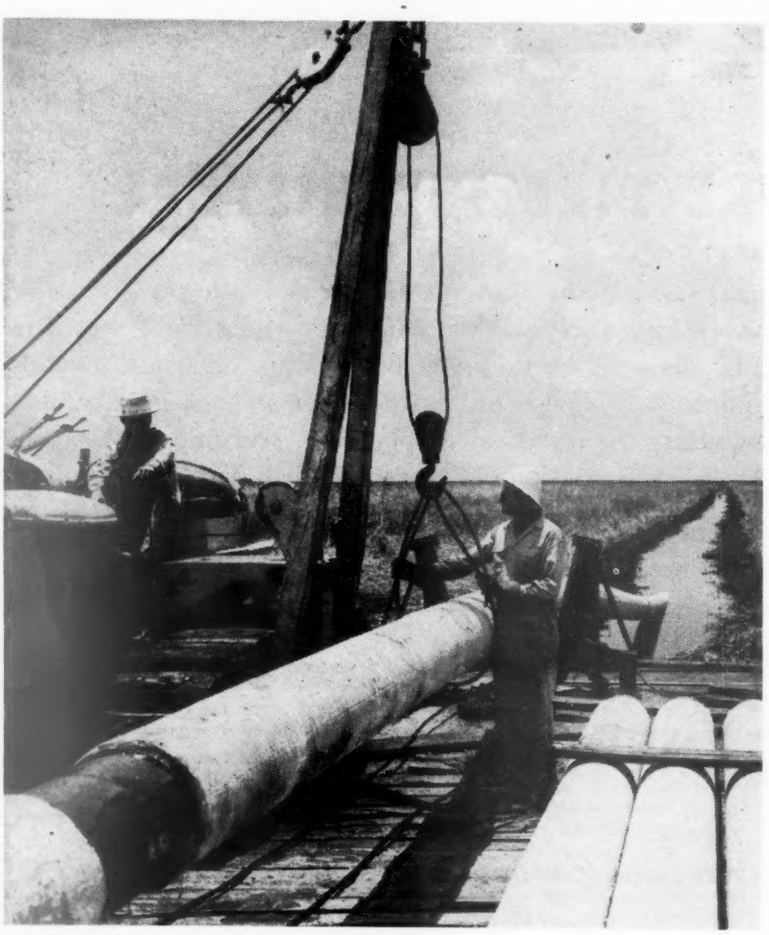
Left—Making ditch with backhoe in swampy spot where conventional ditcher could not be used.
Below—Double-jointing pipe with submerged arc-welding head.





Laying concrete-encased pipe in a Louisiana swamp.

were canal obstructions on both sides of the rivers. The Delaware was a difficult crossing by reason of roads, railroads, canals, and limited working space. The Rappahannock and Savannah had almost solid rock beds.

The most difficult crossing, however, was the Hudson. This crossing is 4300 ft long, water line to water line, and 4800 ft header-to-header. At the point of crossing, from the Jersey shore to the vicinity of the terminus at 134th Street, the crossing is a mile wide. Further, the average depth of the water is 40 ft, both banks are almost solidly built up, and the river carries a heavy traffic in all types and sizes of ships. This last fact made it imperative that the line be placed 25 ft below the river bottom in order that there be no possibility of snagging by ship anchors. A special 26-in. diam, $1\frac{1}{8}$-in. wall pipe was used, manufactured for this particular job to provide maximum toughness and ductility. The reason for this was that the crossing will have a maximum operating pressure of 400 psi, so it was more important to have the pipe possess these chemical characteristics than to have emphasis on a steel that could better resist pressure stresses. This pipe, additionally, was given a $\frac{5}{8}$-in. coating of Somastic.

Compressor Stations

Under the program of compressor station construction five stations were

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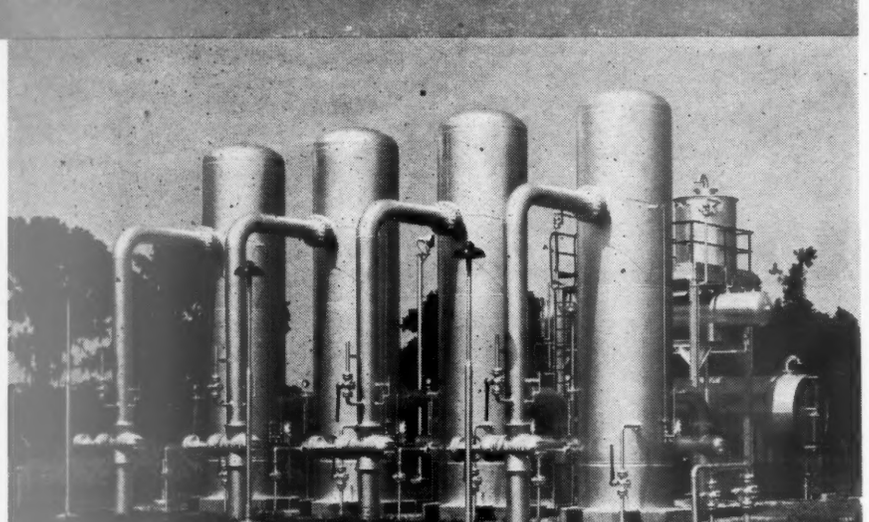


completed in 1949. These were at St. Francisville, Louisiana, (No. 6); Linden, Alabama, (No. 9); Atlanta, Georgia, (No. 12); Mooresville, North Carolina, (No. 15); and Orange, Virginia, (No. 18). At each of the first three named stations, five 2400-hp units were installed, a total of 12,000 hp. At the last two, seven 1600-hp units, totaling 11,200 hp per station, were installed.

Early in 1950, stations were completed at El Campo, Texas, (No. 3) and at Sour Lake, Texas, (No. 4). At each there are four 1200-hp compressor units, a total of 9600 hp.

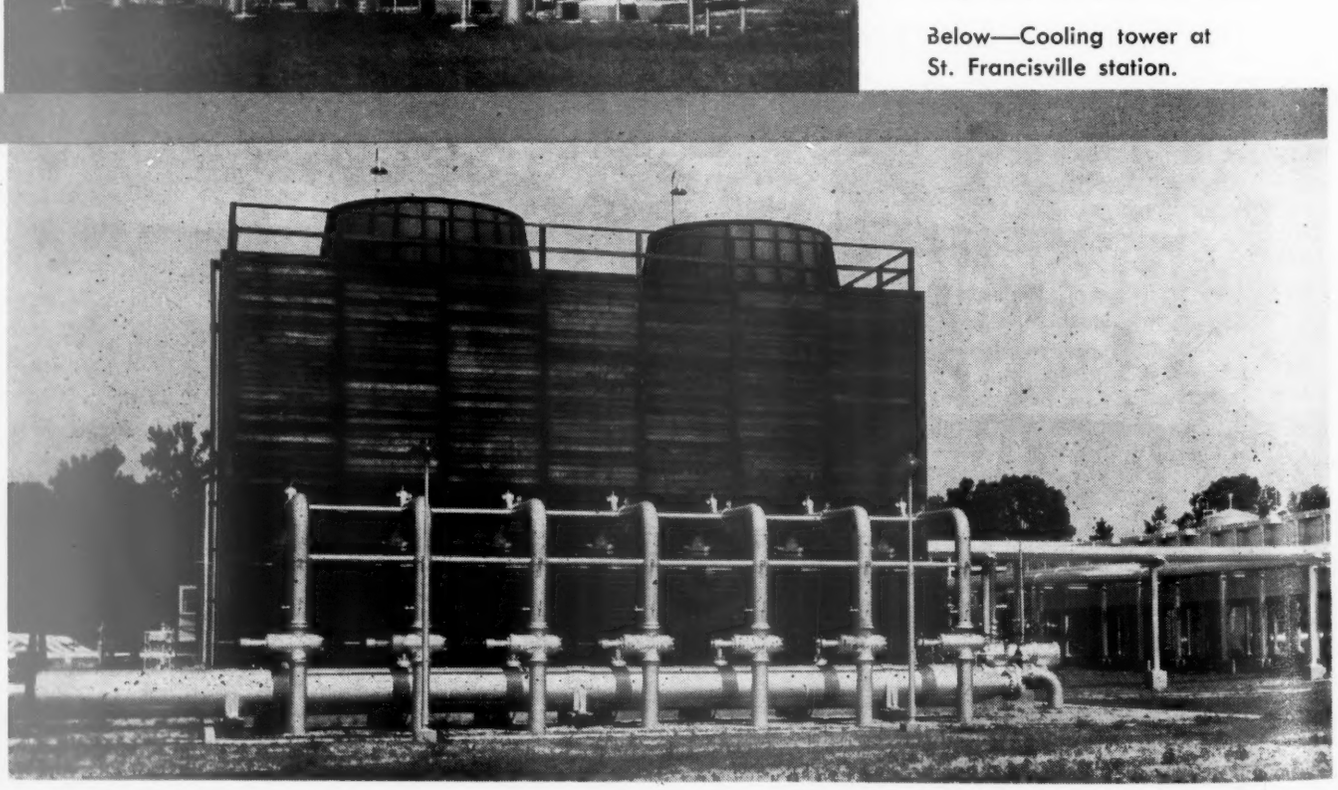
Twelve more stations are now under construction and will be ready to go on the line early in 1951. This will make a total of 19. Three of these will have centrifugal compressor units—Stations 5, 7, and 10. At Station 5 there will be two units having a total horsepower of 8150. Station 7 will have three units totaling 14,830 hp, and Station 10 three units totaling 15,330 hp. The centrifugals will be steam turbine driven, the boilers being fired with gas.

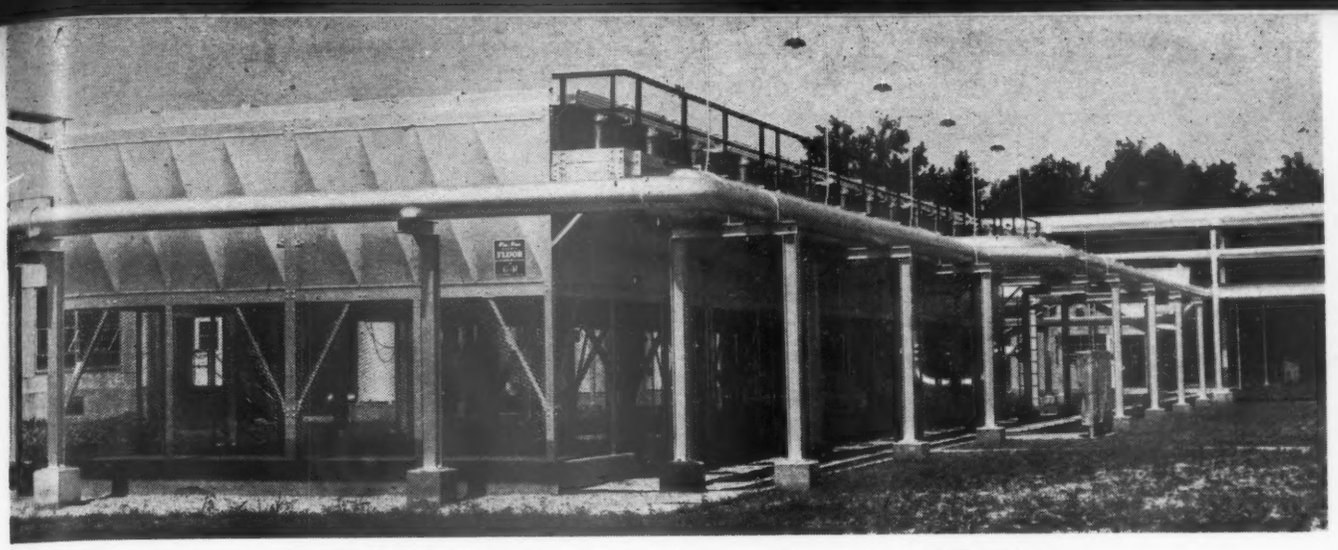
The reciprocating units are of the angle type and have a high compression ratio—1.42 ratio for 100 per cent operation. Their greater efficiency results in less fuel consumption and a

Top—Checking for holidays with a Stearns Holiday Detector.

Left—Gas scrubbers at St. Francisville, Louisiana, compressor station.

Below—Cooling tower at St. Francisville station.





An air-fin installation used for cooling engine water. In some instances they were used to cool gas.

lower heat dissipation rate to the jacket water and lube oil cooling systems. Certain economies are thus effected, such as less cooling system piping and a reduction in the number of pumps and other auxiliaries. The high compression engines also are smaller in size and so require less building area, which minimized building costs.

In the interest of safety, all engines are equipped with the customary shutdown for lube oil failure, high temperatures, and bleeding of fuel gas in case the unit does not start immediately thus preventing filling of the exhaust manifold and muffler with a combustible mixture. The last is a new idea.

One of the features of the compressor stations is the fact that none of the piping is buried, whether for gas or water service. The wisdom of this is apparent in several ways. The lines are readily accessible for maintenance purposes, and, of course, are less subject to corrosion. In case of station enlargement, easy access to the piping will be an asset also. Further, in the initial construction, trenching, doping, wrapping, and back-filling were unnecessary.

Primarily, cooling towers are employed for gas cooling and air-fin units for most water cooling. In some instances, however, the latter are also used for gas cooling. The two-system water cooling arrangement is a conventional installation. For gas cooling atmospheric-type coils are installed in the cooling tower. Water is pumped from the base of the cooling tower through a heat exchanger on the cold system and back over the top, which provides cooling for the cold jacket water that is circulated through the main compressor engines and the auxiliary engine oil coolers. Hot jacket water from both the main compressor engines and auxiliary engine power cylinders is first drained into a surge tank where air is removed. Then it is pumped through the air-fin cooling

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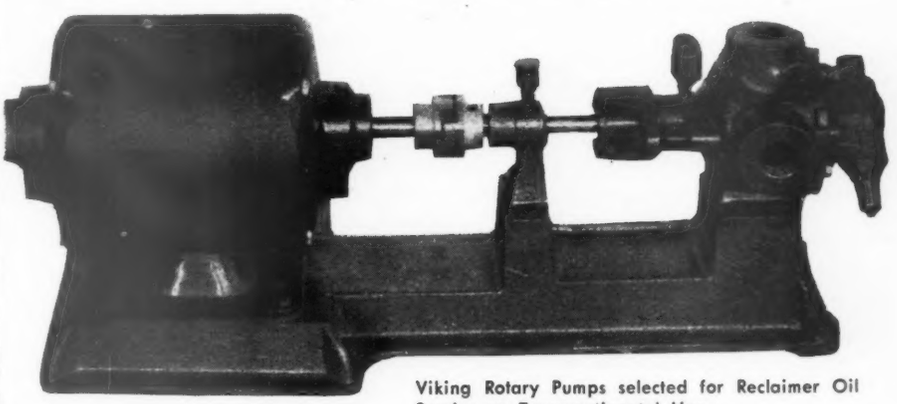

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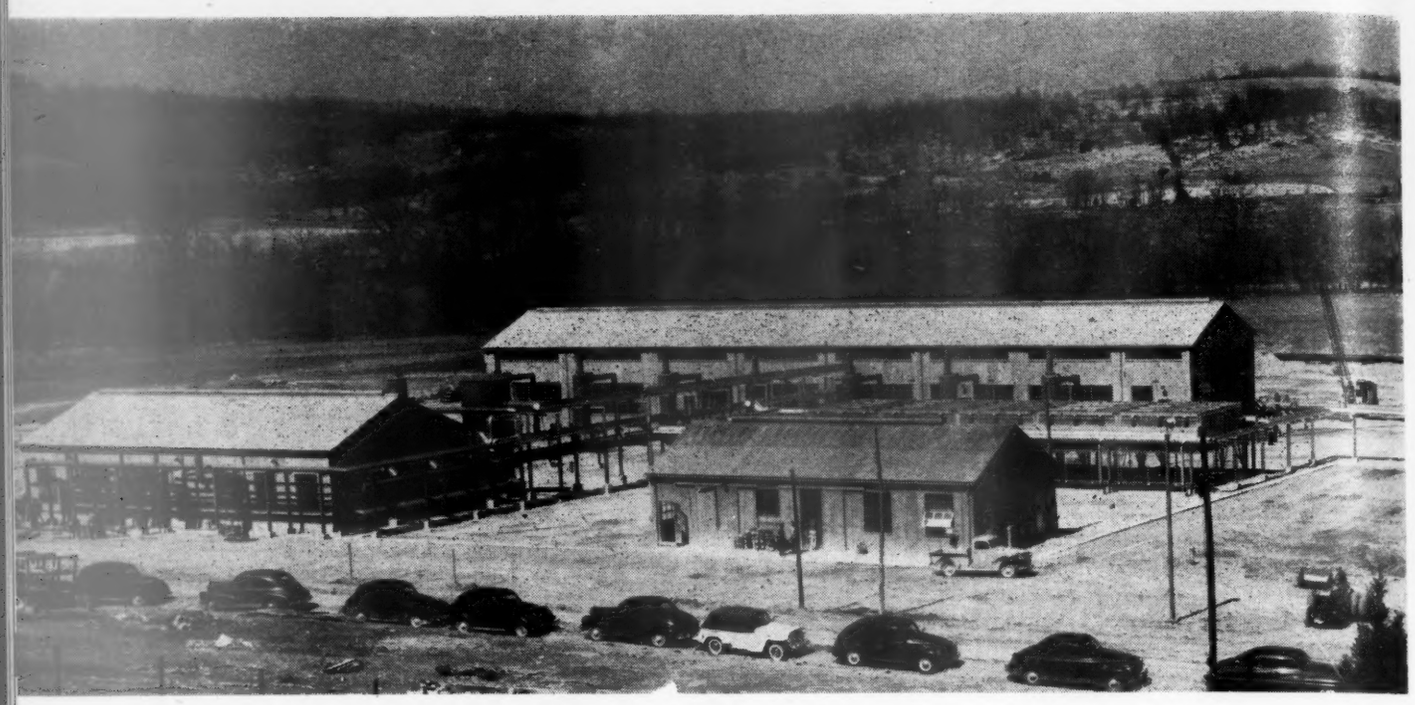


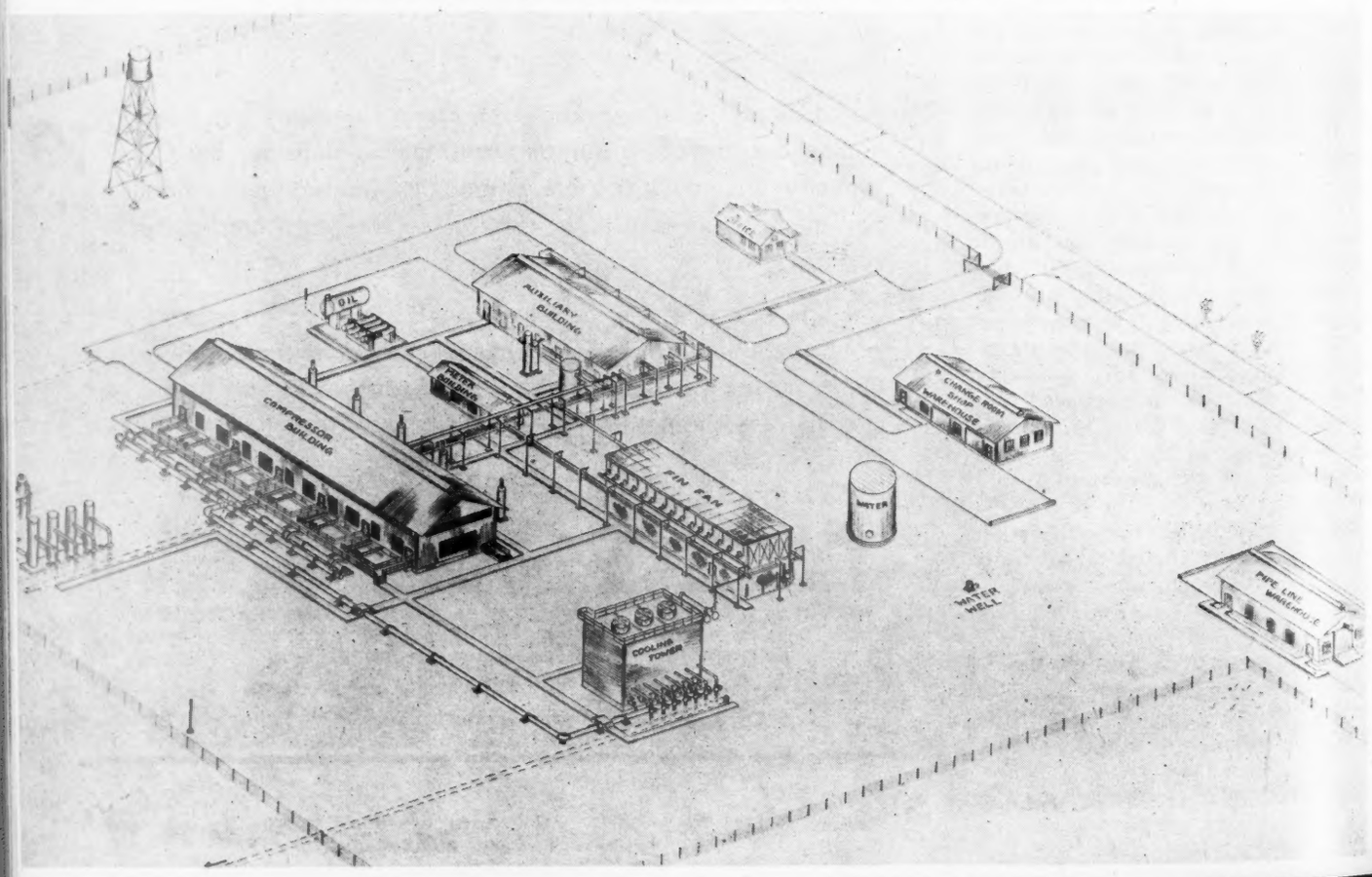
General view of the Orange, Virginia, compressor station.

unit. To prevent sweating of pipes inside the main compressor building, a stream of hot jacket water is diverted through a small fuel-gas exchanger. The fuel gas is thus heated prior to passing through the pressure-reducing regulators into the fuel system.

An important part of any compressor station are the scrubbers for removing foreign material such as pipe scale, dirt, water, etc., from incoming gas. This is essential as a means of protecting compressor cylinder walls, rings, and rods from excessive wear, as well as to provide a gas that is commercially acceptable. The scrubbers used on the Transcontinental system are of the oil-bath type.

The main compressor building and auxiliary buildings are of rigid frame design with asbestos transite covering. A bridge-beam traveling crane to handle heavy machinery parts has its rails suspended above the eave to hold the building height to a minimum. The asbestos covering, used both on the side walls and roof, is fire-proof, long-lasting, has a dampening effect on engine noise, and serves as insulation against hot or cold weather.

Architect's drawing showing typical arrangement of compressor stations.



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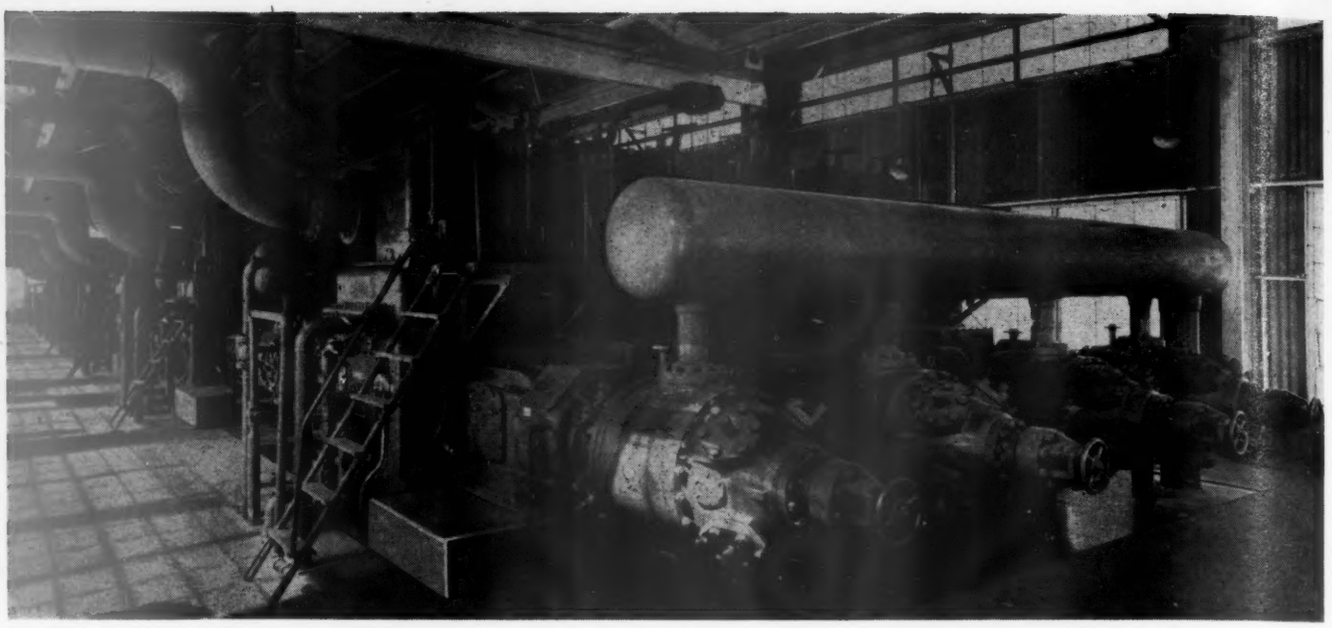

Interior of Orange station where seven 1600-hp compressor units were installed.

Other buildings include one for the office, meters, and a combination machine shop and warehouse. These are sectional, truss-type buildings, with side walls and roof of corrugated galvanized sheet iron. The machine shop is equipped with a lathe, drill press, power hack saw, the usual hand tools, and overhead crane facilities. In the office building lockers and a shower room are provided in addition to the required office space.

Fifteen dehydration plants have been provided for removal of water entering the system. These are situated at producing fields and are of the granular-desiccant type designed to dehydrate gas to a dewpoint of 25 F. equivalent to 6 lb of water per 1,000,000 cu ft of gas at a pressure of 800 psi. The plants and their operation have been described in detail in a previous article in *The Petroleum Engineer.**

The plants are identical in design but vary in size and capacity. The capacity range is from 5,000,000 cu ft to 30,000,000 cu ft a day. There are two towers or contactors, which are used alternately on 8-hr cycles, one being regenerated and the desiccant bed cooled while the other is in operation. The towers are switched automatically every 8 hr by a 7-day time-cycle controller. The units are automatic also in respect to regulation of the amount of gas used for regeneration and to maintain a pressure differential that will allow the regeneration gas to enter the dry gas stream if desired.

The units were prefabricated, with the equipment and piping assembled on a two-section skid base. In the field interconnecting piping was assembled, a direct-fired gas heater installed, insulation provided, and other hook-ups made.

Valve Installations

Main line block valves were installed at intervals of approximately 17 miles and at compressor stations. Most of these valves were 30-in., although there also were some 26-in., 24-in., 14-in., and 10-in. valves used.

*"Natural Gas Dehydration Units Completely Robotized," by C. B. Ames, vice president, Fish Constructors, Inc., *The Petroleum Engineer*, December, 1950, page D-26.

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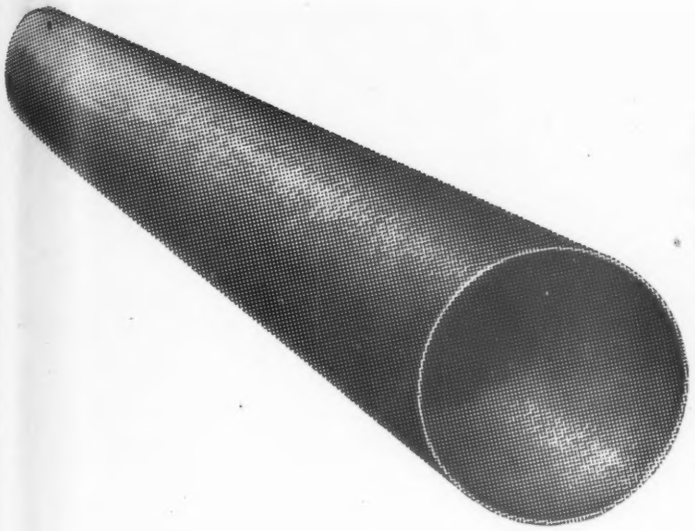
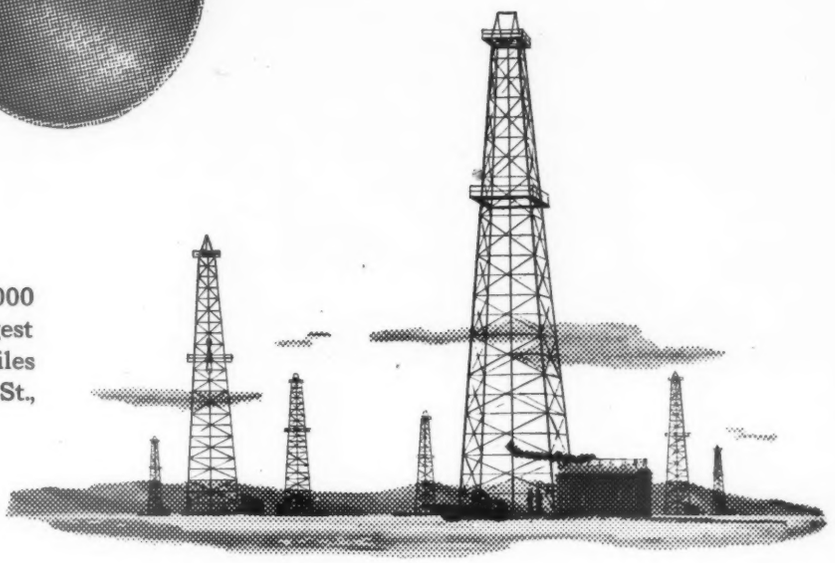
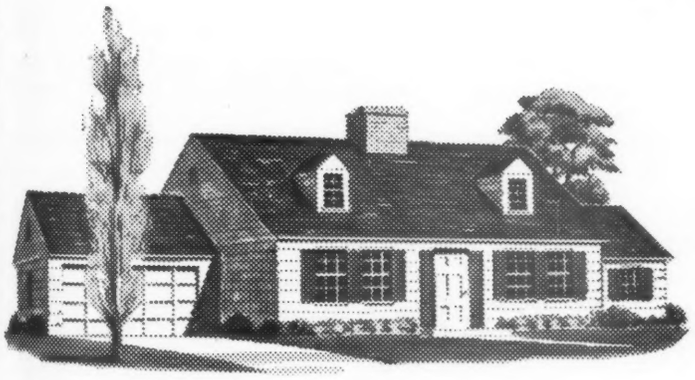


From California came the steel plate which was fabricated into pipe for the big Transcontinental Gas Pipe Line. 470,000 tons of plate—produced and delivered on schedule by Henry J. Kaiser's completely integrated steel plant at Fontana, California.



To Texas and points beyond went 20,000 carloads of this pipe for the world's longest natural gas pipe line... extending 1,840 miles across eleven states... emerging at 132nd St., New York.



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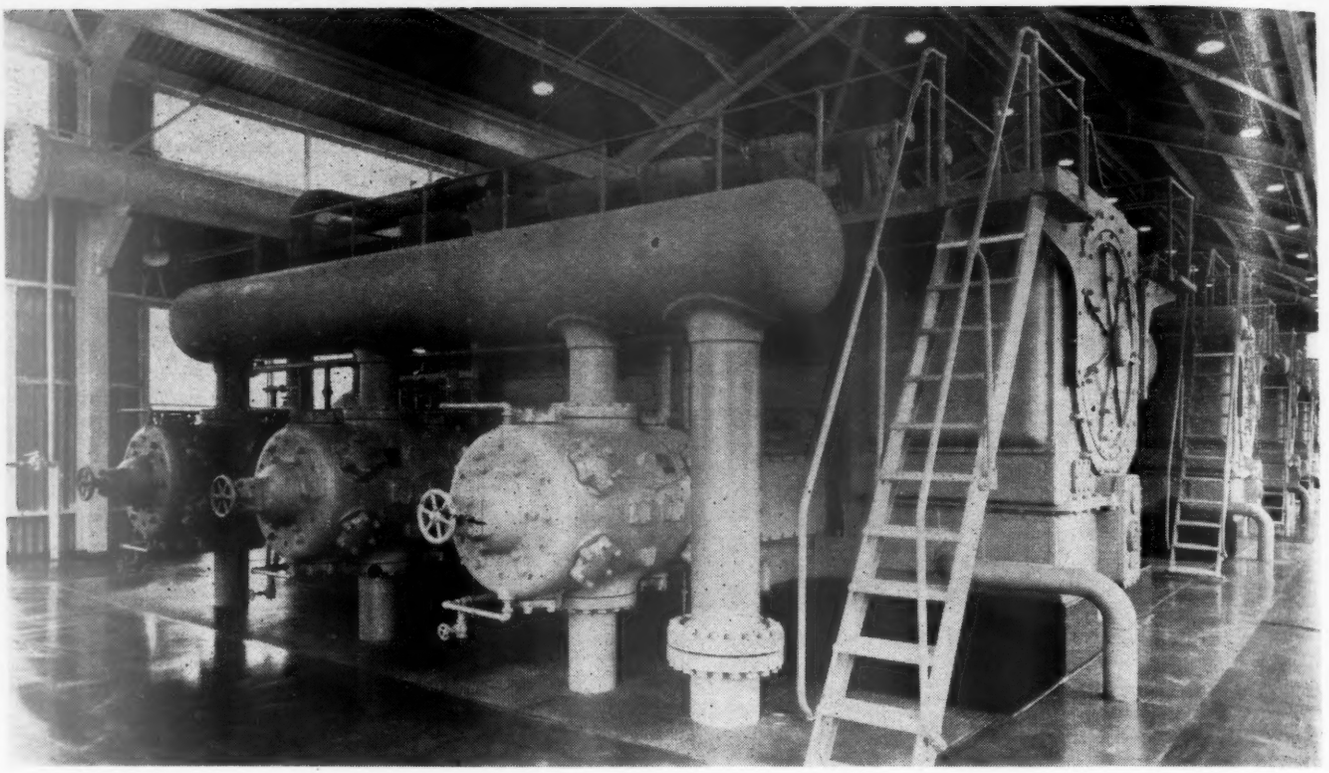


St. Francisville station. Here five 2400-hp compressor units are in operation.

Block valve assemblies were made in a central shop and shipped to the line as needed. These prefabricated assemblies consisted of the main line valve, two blowdown valves, pipe, and fittings. Vent-valve connections were left as stubs and sufficient vent pipe shipped with each assembly. The block valves were installed in accessible locations for the most part. With few exceptions they have been placed near paved or improved roads.

The main line operating wheel, blowdown valves, and lubrication connections extend above ground and these parts are protected by fences or pipe rail guards.

The assemblies are on concrete supports and installation was made after the pipe was laid, the line pipe being cut out to the exact length of the valve assembly.

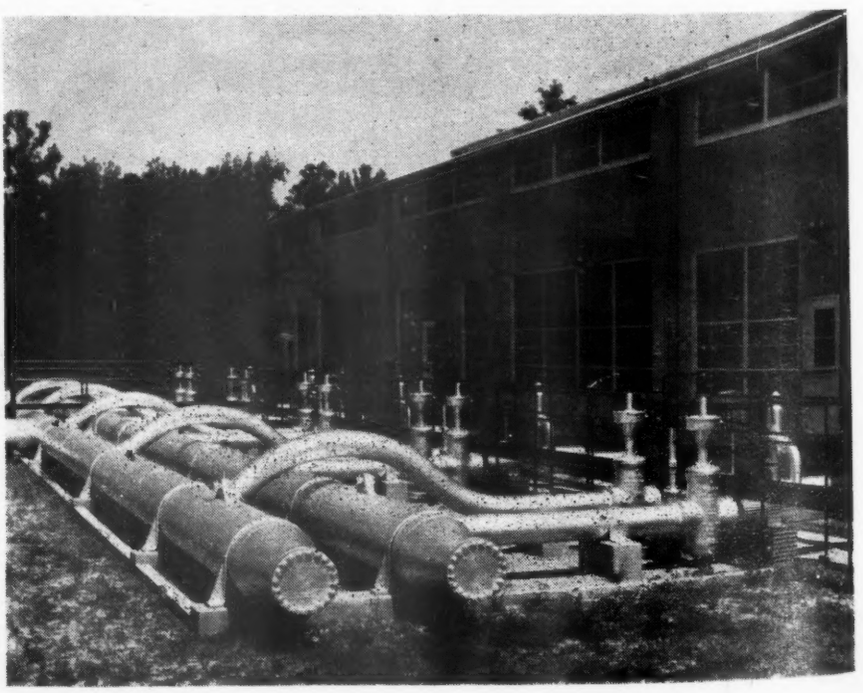
As the block valve assemblies were installed, purging, blowing, and testing of the line was done. The line was tested in accordance with the ASA cross-country piping code, which requires the pipe to withstand a pressure 50 psi greater than working pressure, in this instance 850 psi.

The greater part of the testing was with gas, although 174 miles were tested with water and 22 miles with air. The procedure was as follows: A pig was inserted into the section of pipe ahead of the block valve assembly. The line was then welded to the valve assembly. If water had gotten into the line a squeegee was run ahead of the pig to remove it. After pigging the line it was blown to remove any dust, dirt, mill scale, etc., that may not have been taken out by the pig. The downstream section was then welded to the next valve assembly and the section filled with gas for testing. This left each 17-mile section as completed filled with gas. Thus the line was filled with gas from one end to the other upon completion.

Metering

The objective in designing the metering stations was to hold the volume of lost and unaccounted for gas to 0.5 per cent. The best means of minimiz-

Compressor station suction and discharge headers.



A Salute to Transcontinental

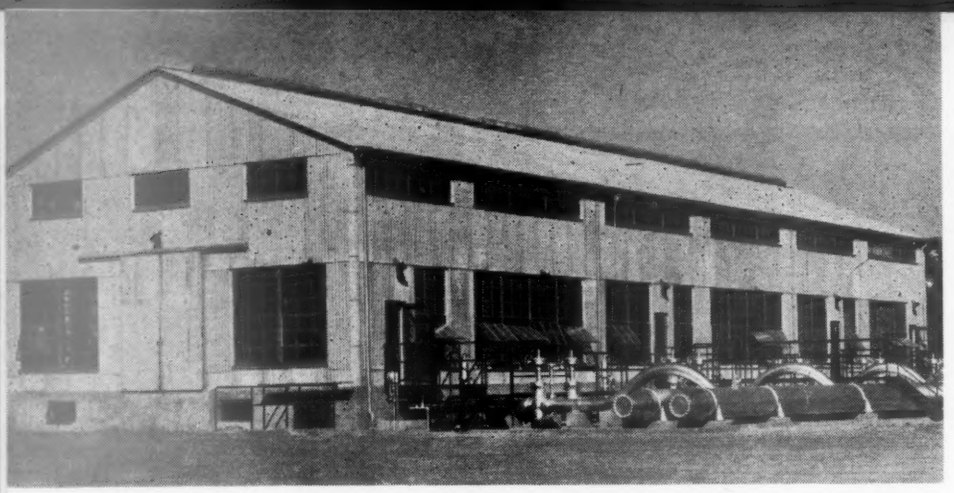
The longest existing gas trunkline system — the Transcontinental — is now being placed in operation. We extend congratulations to Transcontinental Gas Pipe Line Corporation for its signal accomplishment in placing natural gas from the Lower Rio Grande Valley of Texas at the gates of New York City.

Massey Pipe Line Construction Company considers it an honor and privilege to have had a part in construction of this history-making line. We were contractors on Section A in Texas.

Massey services . . . trained personnel . . . best of equipment . . . supervisors with the know-how developed through long experience . . . are available for your pipe line construction jobs. Let us plan for you, work with you.

MASSEY PIPE LINE CONSTRUCTION CO.

CORPUS CHRISTI, TEXAS



A main compressor building of rigid frame design with asbestos transite covering.

ing losses was to install standardized equipment, it was decided.

There are three kinds of meter stations on the system: (1) Purchase meter stations; (2) fuel meters, and (3) sales meter stations.

A total of 25 purchase meter stations have been installed in Texas and Louisiana. These stations, of course, measure gas from producers, gas processing plants, etc. Capacities range from 3,000,000 to 80,000,000 cu ft a day. Normally the gas is delivered at a pressure of 1000 psig, although in some instances the pressure is as low as 800 psig. In all cases the gas is dehydrated before entering the meter runs.

Fuel gas at compressor stations is taken from the station suction. The gas passes through a master meter, but first is heated in heat exchangers and the pressure reduced from 400 psig to 150 psig. At the latter pressure it is metered and the pressure further reduced to 30 to 60 psig, as required by the engines. Fuel gas used for camp and office heating, however, must be further reduced in pressure and the fuel for this purpose is again metered.

Fuel volumes of all kinds range from 2,000,000 to 3,500,000 cu ft a day.

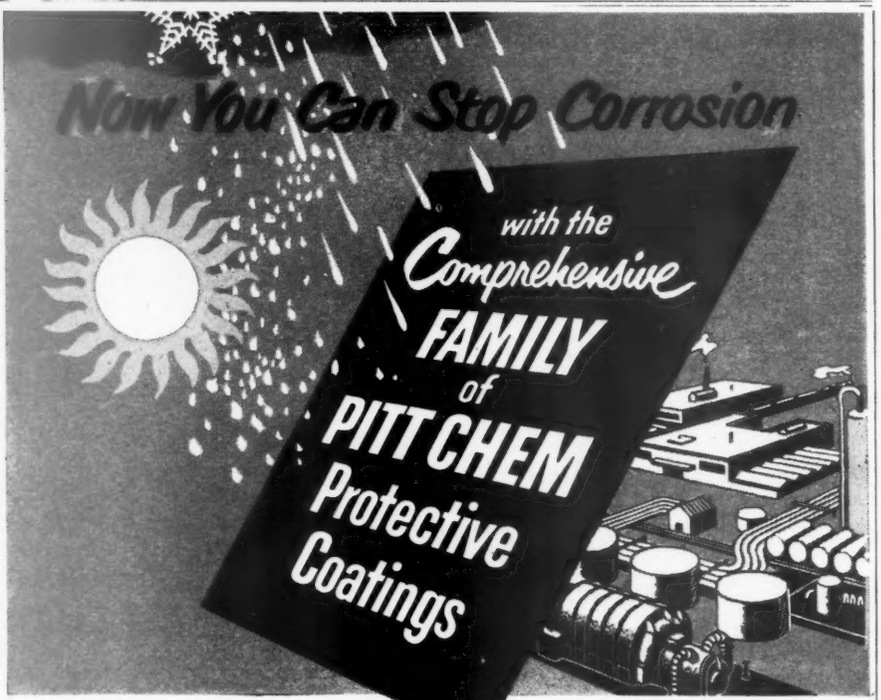
Twenty-one sales meter stations were installed to make deliveries to 13 customers. The major deliveries are at New York City, Newark, and near Philadelphia. The largest volume of gas is delivered from the Manhattan station, which is at 134th Street. Seven check meter tubes were installed and seven sales meter tubes. The check meter tubes were installed immediately after the sales meter tubes, the two sets of tubes thus forming seven 85-ft meter tubes. The gas passing through each tube is thus measured twice by identical equipment and under identical conditions.

At Linden, New Jersey, another special station has been provided for pressure control and check metering. This station is on the main line and can measure as much as 500,000,000 cu ft of gas a day. Equipment consists of four 16-in. meter tubes and four 10-in. pressure control valves. Pressure is reduced to approximately 400 psig.

Other than these two stations all other meter stations, whether for purchase or sales, measure between 1,000,000 cu ft and 80,000,000 cu ft a day. These are dual-tube stations and are a standard unit or "package" type.

Contractors

A pipe line of such proportions would be expected to require the services of a great many contracting firms. Transcontinental is believed to have



★ Hot Applied Tar Base Coatings
★ Cold Applied Tar Base Coatings—Series 100
★ Alkyd Base Coatings—Series 200
★ Chlorinated Rubber Base Coatings—Series 300
★ Vinyl Base Coatings—Series 400
★ Phenolic Base Coatings—Series 500

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Attend the N.A.C.E. Convention in New York City, March 13th to 16th

Stringing Interstate

The pipe line stringing service of J. O. "Red" Willett is now available in 47 states, by I. C. C. permit. Wherever your stringing job may be, whatever the terrain, assign the job to us. You'll get fast, efficient, cooperative service, with assurance that the job will be done right—assurance founded upon experience of management, skill of personnel, pride in doing a job right.

J. O. "Red" Willett's facilities have been used on all of the big lines laid in recent years—many of the smaller ones, too. We were especially gratified to have had an important part in stringing the following sections of the Transcontinental line, now being placed in operation. We strung the first joint of pipe on this line.

87 miles from the Texas line to Eunice, La.

105 miles from Bassfield, Miss., to Tombigbee River, Ala.

83 miles from the Potomac River to the Susquehanna River in Pennsylvania.

87½ miles from the Susquehanna River to the Delaware River.

40 miles from the Delaware River to Elizabeth, N. J.

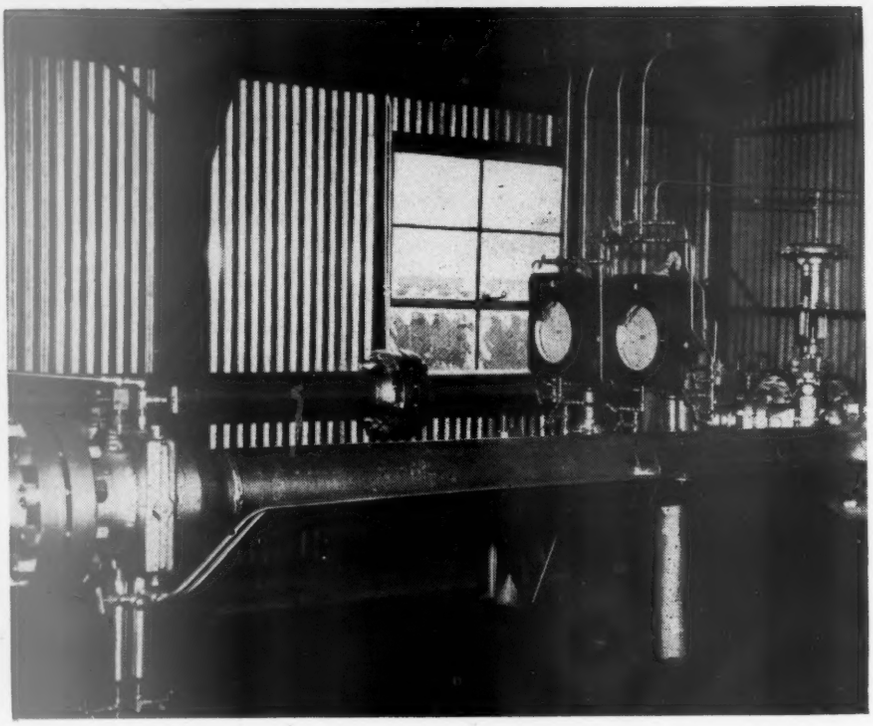
Our compliments to Transcontinental Gas Pipe Line Corporation for being the first to transport natural gas from the fields of South Texas to New York City and Eastern centers.

Get *Stand-Out Stringing Service* by letting Willett handle your next job.

J. O. "RED" WILLETT

Pipe Line Stringer

MONROE, LOUISIANA



A meter setting in the North Markham field, Texas. This is one of the purchase meter stations of which 25 have been installed on the system.

set a record in this respect. Fish Constructors, Inc., designed, engineered, and acted as agents in its construction. In addition, the Fish organization built the compressor stations and dehydration plants. General contractors included Midwestern Constructors, Inc., Latex Construction Company, Texas-Southern Contracting Company, Williams Brothers Corporation, Oklahoma Contracting Corporation, Smith Contracting Corporation, R. H. Fulton and Company, Associated Pipe Line Contractors, Inc., Wunderlich and Griffis Pipe Construction Company, Anderson Brothers Construction Company, Williams Brothers-Davis Company, H. B. Zachry Company, Morrison Construction Company, Victoria Oil Field Construction Company, John Meehan and Associates, Northeastern Construction Company, Massey Pipe Line Construction Company, Pipeline Engineering Company, and Altgelt Construction Company.

Contractors for the suspension bridges were: Colorado and Brazos Rivers, Pittsburgh-Des Moines Steel Company; Coosa River, Austin Bridge Company, and Atchafalaya River, American Bridge Company (superstructure) and Kansas City Bridge Company (substructure).

Other special river crossing contracts were performed by Omaha Dredge and Dock Company, L. E. Farley, Inc., Anderson Brothers Construction Company, and Massman Construction Company. * * *

We are proud to have designed bridges for the Transcontinental Gas Pipe Line

MATTHEWS & KENAN

Consulting Engineers

19TH FLOOR TRANSIT TOWER ★ FANNIN 6462

SAN ANTONIO 5, TEXAS

Specializing in the Design and Construction Supervision of Pipe Line Bridges for more than 25 years.

SERVICE and SINCERITY

The Key Watchwords of Our Organization

We take pride in doing our work well, in our trained personnel, and in our modern equipment.

We look forward to further proving ourselves by being allowed to bid on your work during 1951.

C. WAYNE FOWLER PIPELINE CONTRACTOR, Inc.

Cotton Valley, La.

P. O. Box 368 Phone 84 Night 64

QUICK ACCEPTANCE *in the gas transmission field!*

Pipe line companies purchase over 100 Worthington uniflo design TYPE UTC-16 angle gas engine compressors

It takes time — and actual working conditions — to show how equipment stands up. That explains the keen interest of transmission companies and refineries when the first commercial installation of Worthington's new Angle Gas Engine Compressor TYPE UTC-16, was dismantled for inspection. After 2763 hours of continuous operation — under full load and frequent overload — it was found that:

- **All parts were carbon-free,** demonstrating the marked superiority of Worthington uniflo scavenging over conventional loop scavenging for reducing wear.
- **Pistons and liners were still well within shop tolerances,** and the high polish on the entire liner surfaces indicated A-1 operating condition.
- Rings showed minimum wear, with tool marks still visible.
- Bearings were all in perfect condition.

A Success From The Start

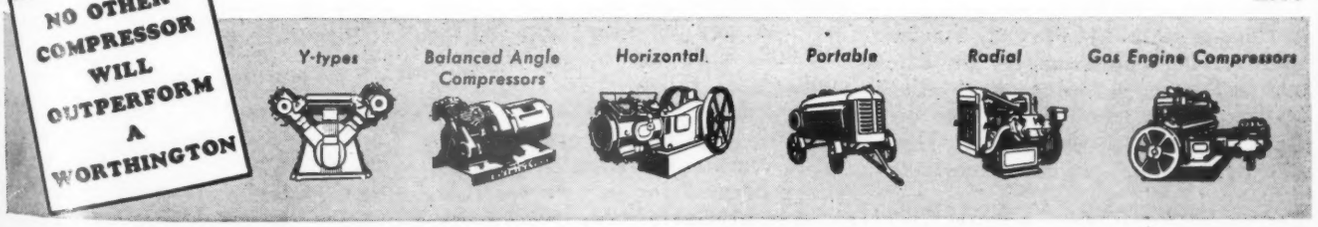
Shop tests had already proved TYPE UTC-16's more thorough scavenging, and perfect combustion. Now, this far more conclusive field test proved the ability to assure these benefits over a long, trouble-free service life. And a steadily growing list of purchasers has established TYPE UTC-16 as a real history-maker in the development of more efficient, more economical gas transmission.

Why not investigate the many advantages of joining this list? Get the whole story that proves *there's more worth in Worthington* from our nearest District Office. Or write to *Worthington Pump and Machinery Corporation, Engine Division, Buffalo, N. Y.*

WORTHINGTON

EK-0-3

NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



Gas Industry Establishes New Records

Further progress is expected in 1951 unless all-out war economy prevents—Transmission and distribution systems total 375,000 miles.

D. A. HULCY*

EACH year since the end of World War II has seen the gas industry registering substantial gains in customers served, in volume of utility gas sold, and in the amount of capital invested in plant and facilities. The industry has grown from a $5,000,000,000 industry to an $8,750,000,000 industry at the end of 1950. Gas utility companies still have allocated under their long range planning, more than $2,500,000,000 to be spent in the next four years, for new construction and expansion of present facilities.

Present world conditions make it impossible to forecast the future with any degree of certainty. Broad scale conversion to defense or war production will increase shortages of materials utilized in civilian production. Manpower shortages may be encountered, and the tax situation may change so as to limit expansion plans. Under normal conditions, the gas industry could be expected to continue its gains during the coming year. At the same time, our industry stands ready now, as it has in the past, to do its full share in helping our nation meet any emergency that may arise.

The spectacular growth of the gas industry was particularly emphasized in 1950 when new records were achieved in customers, volume of sales, total revenues, and sales of gas appliances. Capital expenditures for construction and plant expansion reached a new high level. Transmission and distribution systems of the gas industry grew to reach an amazing total of 375,000 miles, about equaling the total mileage of the combined oil and railroad systems of the nation.

Statistics

The gas utilities at the end of 1950 were serving approximately 24,362,000 customers, including about 331,000 customers receiving LP-Gas directly from utility gas mains. This was a gain of 3.3 per cent over 1949 when there were 23,580,000 customers on gas utility mains.

Of the total number of customers served, 14,894,000 were receiving natural gas, a gain of 12.7 per cent over the previous year. Manufactured gas customers declined about 14.8 per cent during the year to total about 7,197,000 at the year end; while mixed gas customers on December 31, 1950, totaled about 1,940,000, a gain of 24.8 per cent over 1949. The decline in manufactured gas customers can be attributed to changeover by several major gas utility companies from manufactured gas to straight natural gas or mixed gas distribution during the year.

Residential gas customers registered an impressive gain during the year and commercial gas customers also increased in a substantial amount. In addition to the customers reported above it is estimated that nearly 6,000,000 customers now are being served with LP-Gas, mostly in rural areas not reached by utility gas mains.

Total sales of utility gas in 1950 amounted to 4,266,000,000 Mcf, a gain of about 15.8 per cent over 1949. Sales of natural gas were about 3,694,000,000 Mcf, a gain of 18.9 per cent; manufactured gas sales dropped to 412,400,000 Mcf, a decline of 2.7 per cent, and mixed gas sales were about 159,600,000 Mcf, a rise of 14.4 per cent over the previous year.

Revenues from the sale of gas reached an all-time record in 1950, rising almost to the $2,000,000,000 mark. Utility revenues for the year were approximately $1,958,000,000, a gain of 16 per cent over 1949. Natural gas revenues staged a spectacular rise of 25 per cent to total $1,363,000,000 for the year. Manufactured gas revenues were $458,700,000, a decline of 4.3 per cent under 1949, and revenues from sales of mixed gas were $114,600,000, a gain of 18.8 per cent over the previous year. The balance in revenues was accounted for in revenues from sales of LP-Gas through utility mains.

New Facilities

The gas industry's expenditures for construction of new facilities and expansion of present production, transmission, and distribution plant last year reached a record level of approximately $1,060,000,000, attesting to the tremendous effort the gas industry is making to meet the constantly growing demand for gas. Of this total amount it is estimated that more than $954,000,000 was spent on construction and expansion of natural gas pipe line systems, with manufactured gas companies spending about $90,000,000 and mixed gas companies investing nearly $15,000,000 for new plant and expansion of present facilities.

The American Gas Association resurveyed the gas industry's expansion program last year and estimates indicated that about $3,154,000,000 would be spent in the five-year period 1950-1954, with approximately $2,750,000,000 of this amount being devoted to construction and expansion of natural gas facilities. While it is believed that 1950 will be the peak year of this program, it is estimated that more than $875,000,000 will be spent on gas industry expansion next year if no restrictions are placed on vital materials.

Gas Appliances

Sales of gas appliances reached new high levels in 1950, exceeding the record heights achieved in 1947 and 1948 when the industry was filling the tremendous backlog of appliance orders that had accumulated during the war years.

Sales of gas ranges, for instance, last year totaled more than 3,100,000 units, compared with 2,100,000 in 1949 and a previous record of 2,800,000 units in 1948.

Natural Gas Progress

The natural gas industry reached new peaks in 1950 and gave every indication that it will progress further in the year ahead unless it is stymied by all-out war economy.

*President, American Gas Association. President, Lone Star Gas Company, Dallas, Texas.

30 digging feeds range from 18½ to 585 lineal ft. trench per hour.

Wide work range. . . Model 250 digs 16 to 42" wide at 12'-6" depth.

15 cutting widths are available with only 4 standard size buckets, side cutters and oversize teeth.

Replaceable tooth points . . quickly installed, self-sharpening, get full bucket load every bite.

Alloy and heat-treated steels in bucket chains keep maintenance low.

Telescopic boom locks at 12" intervals for quick depth changes.

Reversible conveyor shifts by power through machine in 1 minute.

Friction clutches control digging, boom hoist, steering, traction, engine.

Automatic safety clutch protects all machinery from shock loads.

Low center of gravity assures safe Trenchliner operation for work and travel over uneven terrain.

Tractor-type,self-cleaning crawlers have 7 lbs. PSI pressure.

Fully-enclosed gears in constant oil bath assure steady, trouble-free operation with 250 Trenchliner.

Call your Parsons distributor now for more complete information on this heavy-duty 250 Trenchliner, or for facts on all other Parsons models.

PARSONS CO., Newton, Iowa

P130

PARSONS HEAVY BEARING PRODUCT

PARSONS *Trenchliners*®

KOEHING SUBSIDIARY

In the first nine months of 1950, the Federal Power Commission approved construction of 5750 miles of new natural gas transmission lines and had applications pending for an additional 12,400 miles. Construction of the approved lines will bring the total mileage of the nation's natural gas transmission system to more than 265,000 miles.

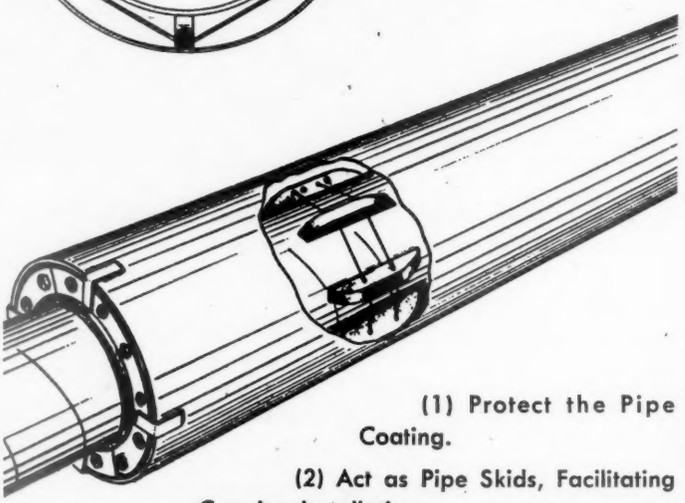
The Transcontinental Gas Pipe Line Corporation scheduled delivery of natural gas to New York City, Brooklyn and Newark at the end of December, 1950. This 1840-mile line, the longest in the world, brings gas from the Gulf Coast to New York and construction cost of the line was nearly $200,000,000.

The Federal Power Commission has authorized one transmission company to bring natural gas to the New England states and approval of the application of a second company is contingent upon evidence of a sufficient supply of natural gas to service the remainder of the New England area. Natural gas has been promised to New England by the end of 1951. This will leave the Pacific Northwest as the only part of the country not served with natural gas, and several plans are under consideration for bringing natural gas to this area.

THE PIG WITH THE POKE — CLEANS PIPE LINES

WILLIAMSON "CONCENTRIC SUPPORT" PIPE LINE CASING INSULATOR*

This improved Williamson Pipeline Casing Insulator approximately centers the line pipe in the casing. This removes support of pipe from "WmSEAL" Casing Bushings, and facilitates their installation. In addition, Williamson Pipeline Casing Insulators:



(1) Protect the Pipe Coating.

(2) Act as Pipe Skids, Facilitating Crossing Installations.

(3) Separate Pipe and Casing, Assuring Insulation for Cathodic protection.

*Patents Pending.

T. D. Williamson, Inc.
TULSA 9, OKLAHOMA

Natural gas reserves are ample to serve the nation for many years to come, despite the rapid increase in the production and use of natural gas. The AGA's committee on natural gas reserves estimated at the beginning of 1950 that proved reserves of natural gas totaled 180.3 trillion cubic feet, an increase of 6.5 trillion over proved reserves at the beginning of 1949. Natural gas production during 1949 was estimated at 5.9 trillion cubic feet. New discoveries and extensions of estimates of known fields continue to exceed the yearly production.

Manufactured Gas

Despite the tremendous growth of our natural gas systems, the manufactured gas branch of the industry continues to be of the utmost importance in the nation's economic picture. Demand for gas services continues to exceed the ability of the industry to meet this demand in many areas. This is particularly true as regards house heating and its attendant peak-load problem.

While some of the territories receiving or about to receive natural gas will change over to straight natural gas distribution, there are many companies that will continue to manufacture gas and will use natural gas only as one of the production materials. Other companies will mix manufactured gas and natural gas to be served, perhaps at higher Btu levels. These companies still will rely heavily on their manufactured gas plants.

Conclusion

There are many factors that point the way to a continuation in 1951 of the record breaking achievements of the gas industry in 1950. Except for a few areas, the gas supply problem is being solved rapidly through the growth of the natural gas systems and the advances in manufactured and mixed gas plants that are helping solve the peak load problems. Our member companies have expressed their faith in the future of the industry with continued contributions to the Association's Promotion, Advertising and Research (PAR) Plan.

Rising costs of producing, transmitting, and distributing gas indicate some further rate adjustments may be necessary, particularly if the tax burden of the gas utilities is increased appreciably. Shortages of materials, resulting from major conversion to war production, would necessitate delays in construction and expansion programs as well as limiting production of gas appliances. These are matters mostly beyond the control of the gas industry. * * *

19 LORAINS *LEAD THE WAY ON THE BIG BECHTEL JOB*

THE TEXAS-ILLINOIS Natural Gas Pipeline is "loaded" with Lorains. 19 of them set the pipeline pace for Bechtel Corporation on the 409 mile, 30 inch gas line that covers the terrain from Texarkana, Arkansas, to Cape Girardeau, Missouri.

1. "PIPELINER SENIORS" — *5 of them — handle ditches on the Bechtel Corp. job. Crawlers, 13 ft. in overall width, straddle the ditch, with plenty of clearance to prevent cave-ins. Note the 60 in. wide crawler tread extensions designed and installed by Bechtel.*

2. LORAIN 50-K CLAMSHELLS *with 14 foot-long crawlers provide the soft-ground flotation necessary to carry the line through soupy, runny mud and muck like this.*

3. LORAIN 50-K's — *11 of them — provide the 14 foot-long crawlers for low-ground pressures necessary to "float" draglines in the soft spots, like this one. Again "Bechtel-built" 60 in. wide tread extensions are used.*

4. LORAIN-80 DRAGLINES — *2 of them — work with 1-3/4 yd. buckets to dig the approaches for 2 crossings of the nearby White River.*

In Bechtel's line up of 19 Lorains on this job, there's plenty of variety in capacities, booms and mountings . . . as well as on the jobs the Lorains handle. As hoes, clamshells and draglines, they're doing just about everything, as these pictures show . . . and it's the Lorains that usually get the calls when there are emergencies in "soupy" or tough going. Bechtel's big Lorain fleet has helped keep men and machines ahead of schedule.

Heading this big Lorain pipeline "parade" are 16 new Lorain-50's . . . 11 of them with 14 foot-long crawlers ideal for dragline and soft-ground duty . . . 5 "Pipeliner Seniors" on 13 foot-wide "ditch-straddling" crawlers. *There are Lorains to fit every pipeline need. Your Thew-Lorain Distributor will prove it! Ask him!*

THE THEW SHOVEL COMPANY • LORAIN, OHIO

THEW® LORAIN PIPELINER

PICTORIAL

The Pipe Line Contractors Association held its third annual convention at the Shamrock Hotel in Houston, Texas, during January, the largest in point of attendance yet held. On these pages are some "unrehearsed" shots taken during the meeting.

The outgoing president, Ray L. Smith, congratulates Larry Favrot, the new president.

Fred Byers, Eastern Construction Company; "Red" Peddy; C. Hobson Dunn, Eastern Construction Company; O. R. Smith, Smith Contracting Corporation, and Earl Allen, Associated Pipe Line Contractors.

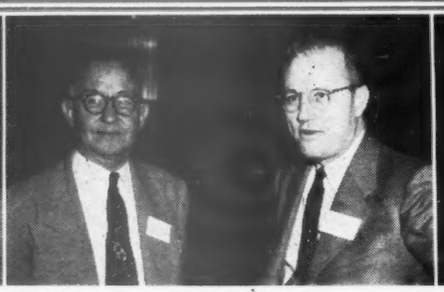
L. R. Young, Young Construction Company, and John M. Harvey, Perrault Brothers.

Ernie Esgate, Thew Shovel Company; L. B. Cummins, Atlas Equipment Corporation; C. S. Callicoatte and George H. Thompson, both of Thew Shovel; Lee Craggs of W. T. McClure; C. S. Weber and R. T. Cobb of Thew Shovel; Jim Conlan of W. T. McClure.

A. E. Tedeschi, Texas Road Boring Company; T. A. Hester and M. E. Shifflet, Oklahoma Contracting Corporation.

Bobby Siegfried, R. H. Siegfried Company; R. D. Sheehan, Sheehan Pipe Line Construction Company; Lou Dauer, Trackson Company; J. H. Nolan, Sheehan Pipe Line Construction Company.

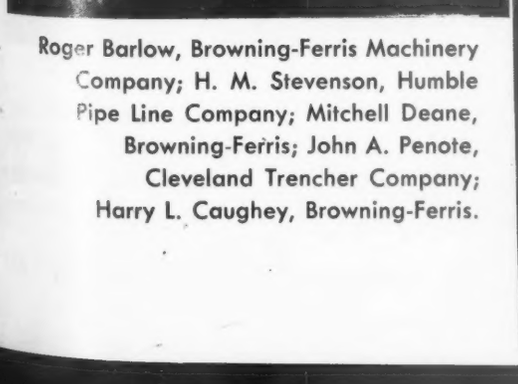
N. F. Blundell, assistant chief engineer, and F. S. Young, chief engineer, Trunkline Gas Supply Company.



Tom Jones and M. W. Staples, Oklahoma Contracting Corporation.

Felix M. Johnson of the Trojan Construction Company and H. C. Price of H. C. Price Company.

Below, D. M. "Mike" Curran, M. J. Crose Manufacturing Company, Inc.; T. P. F. Kelly, James E. Mavor Company; D. D. Kennedy, D. D. Kennedy, Inc.; J. W. Dunbar; R. D. Gagney, Contracting and Materials Company.



Roger Barlow, Browning-Ferris Machinery Company; H. M. Stevenson, Humble Pipe Line Company; Mitchell Deane, Browning-Ferris; John A. Penote, Cleveland Trencher Company; Harry L. Caughey, Browning-Ferris.

E. L. Launder, H & L Tooth Company; Don Lutz, Bucyrus Erie; "Tex" Eustace, Shanks and Eustace; A. R. Kurtz, Jess McNeel Machinery Company.

Paul R. Halbert, Oklahoma Contracting Corporation; W. G. Hanrahan; M. W. Staples, Oklahoma Contracting, and E. J. Mahoney, Jr., Mahoney Contracting Company.

Bennie Means, Pittsburgh Coke and Chemical Company, and Steve Day, S. D. Day Company, who have been associated in business for more than 20 years.

Roy Clark and J. C. Britton of Britton Contracting Company.

Leon V. Shaw, Shaw Equipment Company, and Francis Fabick, John Fabick Tractor Company.

E. R. Rathjen and Ellis Dunn, Dunn Brothers; Jim Cummings, Crutcher-Rolfs-Cummings, Inc.; J. H. Anderson, Anderson Equipment Company; A. S. Crutcher, Crutcher-Rolfs-Cummings.

L. E. Farley, L. E. Farley, Inc.; Ben Carter, Fish Constructors, Inc., and O. E. "Ted" Murrey, Midwestern Engine and Equipment Company.

The Vertical Aerotec Gas Scrubber sectioned to show Aerotec tubes, heart of this new scrubbing principle.

Proof

. . . that AEROTEC GAS SCRUBBERS *Really* clean gas

This pilot installation at Alice, Texas, used on very dry gas, was first installed on the discharge of a conventional type gas scrubber (position of first installation shown by arrows). In 18 hours of operation, this Aerotec unit collected 2 quarts of liquid, from gas that had passed through the conventional unit.

Installed at the inlet to the conventional gas scrubber, only one teacup of fluid was collected from the conventional type in 8 days, and this was probably condensation.

This is a typical example of field reports on the high efficiency of Aerotec gas scrubber units. Based on a modification of the principle of separation used in dust collection, Aerotec units have produced outstanding results, both at the well and on pipeline applications.

A catalog on operating and application data will be sent on request. Just write our Project Engineers, or the field office nearest you.

Project and Sales Engineers

THE THERMIX CORPORATION

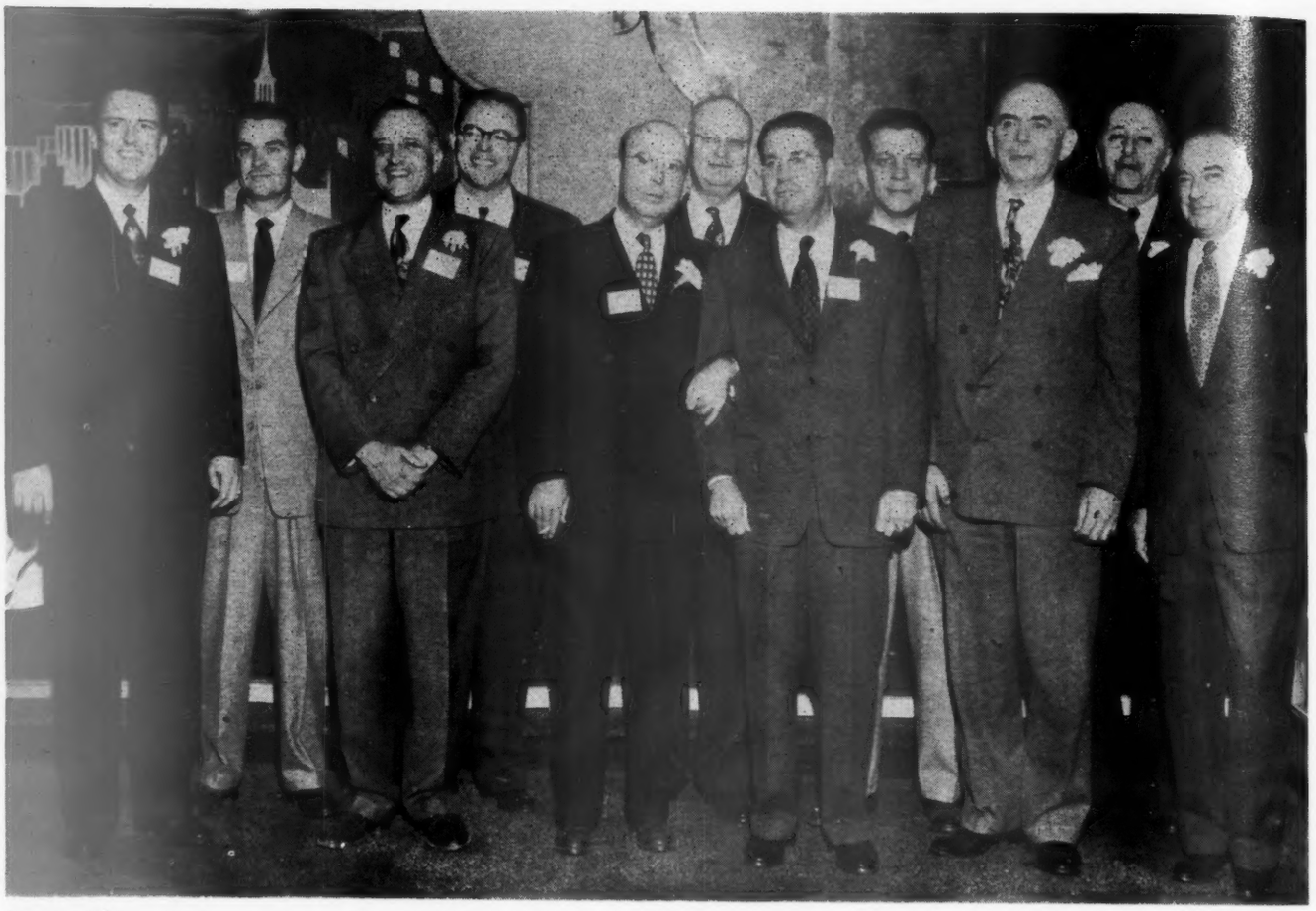
Greenwich, Connecticut

(Offices in 28 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., 1440 Saint Catherine St., W., Montreal 25, Quebec; 50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.



New Officers: Richard A. Gump, E. G. Morrison, Clark C. Bledsoe, E. J. Mahoney, Jr., T. A. Hester, Ray L. Smith, L. H. Favrot, M. S. Williams, Robert A. Conyes, N. A. Saigh, and H. C. Price. Robert Thomas not in picture.

CONTRACTORS HOLD THEIR BEST MEETING

THE third annual meeting of the Pipe Line Contractors Association, held at the Shamrock Hotel in Houston, Texas, January 9 and 10, proved to be the most outstanding gathering of that organization during its brief history. Formed only 3 years ago, the registration this year totaled 400 as compared with 175 a year ago, and 125 at the first meeting. Quality of the program, and the general conduct of the convention, have shown similar progress. Significant of the interest the contractors have in their organization is the fact that all but 4 contractor members were present at the meeting.

Ray L. Smith of El Dorado, Kansas, president of the association, called the convention to order and delivered the address of welcome.

Discussed at the first session was the possibility of the association's producing a motion picture for the natural gas industry. Numerous pictures have been made by individual gas companies, and some have included manufactured gas, but the purpose of this picture would be to confine its story to the natural gas industry. The contractors association previously had expressed a willingness to perform such service if it met with approval of the gas industry. Present at the meeting as representatives of the latter were Jim Floyd of the Lone Star Gas Company and Bob Suttle, managing director of the Southern Gas Association, to discuss the matter and assure of the gas industry's cooperation.

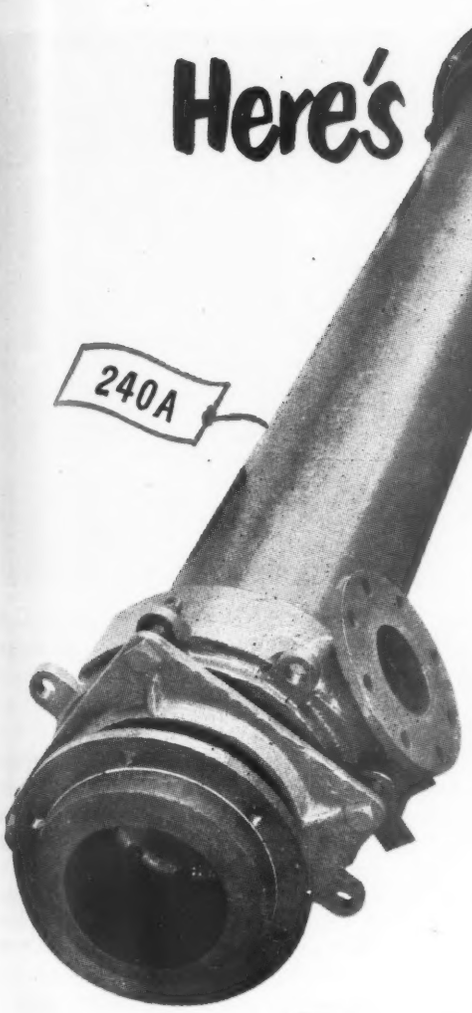
The technical part of the session was a paper on "X-Ray Inspection—Weld and Plate Defects on Pipe and Their Interpretations," by W. A. Saylor, chief metallurgist, Consolidated Western Steel Corporation, Los Angeles.

The opening matter of business on the second day of the meeting was the annual report by the executive secretary, Richard A. Gump. He cited the increase in attendance figures, already given, as concrete evidence of the growth of the association, and also stated that active membership now totals 36 contracting firms and associate members number 57. Gump also discussed briefly the aims and accomplishments of the association.

He was followed on the program by P. M. Mattisen, of Price, Waterhouse and Company, Houston, certified public accountants, who gave an address that was timely and of great interest. His subject was "Federal Income Tax Matters of Interest to Contractors."

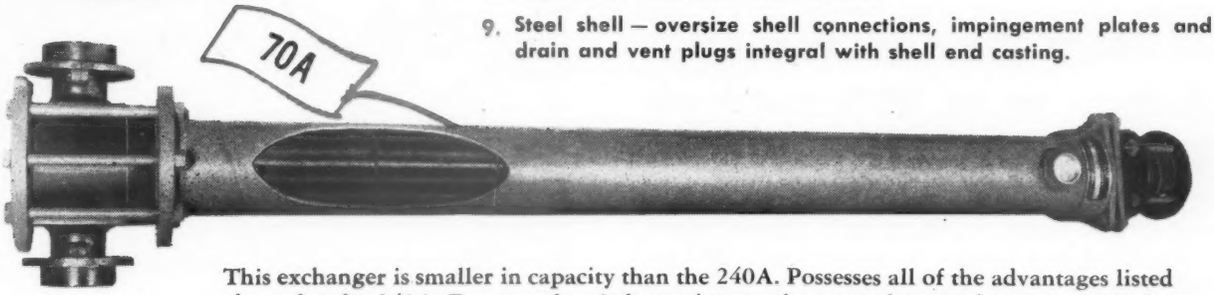
The luncheon at noon in the Shamrock Room had as hosts the Motor Truck and Industrial Divisions of the International Harvester Company and the Superior Equipment Company, Bucyrus, Ohio.

Here's the dope on 2 "KARBATE" IMPERVIOUS GRAPHITE HEAT EXCHANGERS



The new No. 240A is a shell-and-tube heat-exchanger made of "Karbate" brand impervious graphite . . . similar in construction to the familiar No. 70A . . . but with almost three times as much total effective external heat transfer surface. Advantages are:

1. **70.6 sq. ft. of external heat transfer surface.**
2. **Single, double or four-pass routing of tube-side fluid is effected by a simple change of fixed and floating end-cover assemblies.**
3. **Wide variety of corrosive fluids handled with negligible maintenance.**
4. **Thermal shock resistance.**
5. **Very high heat transfer rates.**
6. **Stainless steel baffles.**
7. **Easy tube replacement in the field.**
8. **Removable "Karbate" tube bundle.**
9. **Steel shell — oversize shell connections, impingement plates and drain and vent plugs integral with shell end casting.**



This exchanger is smaller in capacity than the 240A. Possesses all of the advantages listed above for the 240A. For complete information on these two heat exchangers, write for catalog sections S-6715 and S-6690. Address National Carbon Division, Dept. **PE.**

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- **Will not swell, stick or jam in a flashlight.**

Why? Because of the *exclusive* "inside-out" construction of the "Eveready" No. 1050 battery. Instead of being the container for the cell, the zinc electrode is on the inside to make the battery last longer, while the new outside carbon jacket makes the battery leakproof. Order a supply of No. 1050's *today*.

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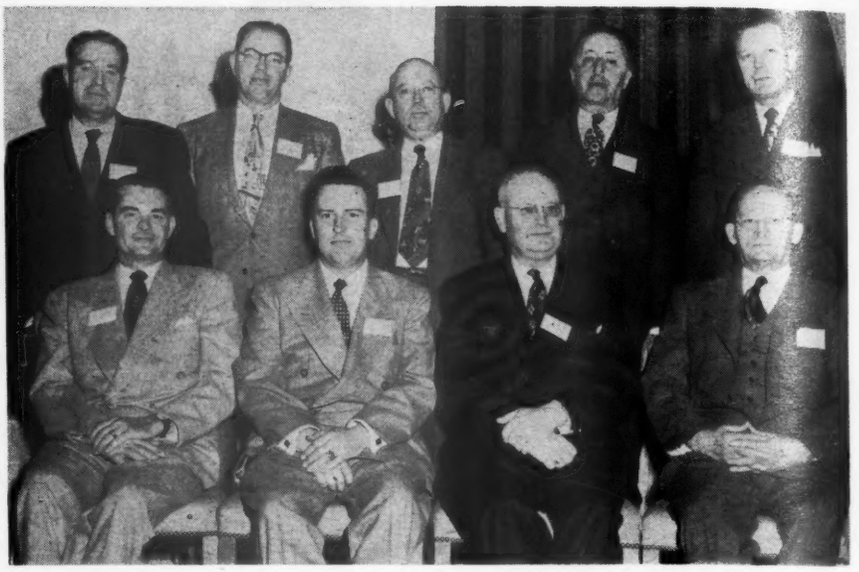
The afternoon meeting was a closed business session for active members only at which new officers were elected. These are: L. H. Favrot of the Houston Contracting Company, Houston, Texas, president; Robert A. Conyes, Conyes Construction Corporation, San Pablo, California, vice president; Robert Thomas, Texas-Southern Contracting Company, Fort Worth, Texas, vice president; E. J. Mahoney, Jr., Mahoney Contracting Company, Mt. Pleasant, Michigan, treasurer, and Richard A. Gump, Dallas, executive secretary.

The new directors are: T. A. Hester, Oklahoma Contracting Corporation, Dallas, Texas; Ray L. Smith, Ray L. Smith and Son, Inc., El Dorado, Kansas; Clark C. Bledsoe, Midwestern Constructors, Inc., Tulsa, Oklahoma; M. S. Williams, Anderson Brothers Corporation, Houston, Texas; H. C. Price, H. C. Price Company, Bartlesville, Oklahoma.

Holdover directors are: Robert A. Conyes; L. H. Favrot; Robert Thomas; E. J. Mahoney, Jr.; E. G. Morrison, Western Construction Company, Austin, Texas, and N. A. Saigh, N. A. Saigh Company, Inc., San Antonio, Texas.

In the evening a cocktail party was sponsored by the Thew Shovel Company, following which was the annual banquet. At the latter the new officers were introduced, entertainment provided, and a talk given by C. A. Kothe of Tulsa, Oklahoma, on the subject "Are You Listening."



1950 Officers: Front row, E. G. Morrison, Richard A. Gump, Ray L. Smith, C. S. Foreman. Back row, L. H. Favrot, E. J. Mahoney, Jr., T. A. Hester, N. A. Saigh, Robert Thomas.

Two resolutions were adopted by the association. One expressed the readiness of members to serve the country to the utmost in the national emergency, offering any or all facilities that the government may request.

The other resolution was an expression of sympathy to the family of J. R. Horrigan, a charter member of the association, who lost his life in a plane accident during the summer.* * *

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Joint Cathodic Protection Systems

Techniques of Design and Installation—Possible Division of Responsibilities for Construction, Operation, and Maintenance—Sharing of Costs

BULLETIN 1 prepared by the Correlating Committee on Cathodic Protection informs management about the economic value of cathodic protection for combating underground corrosion of buried metallic plant. This corrosion and its contingent losses are costing American industry about a billion dollars per year.

Bulletin 1 describes in layman's language how such corrosion, which is a chemical attack of Nature, can be stopped by cathodic protection, which consists in impressing suitable external electric currents into the structures via metal masses called "anodes" buried in the soil nearby.

The bulletin points out that such external currents, beneficially impressed for the protection of one structure, can stray through the soil and cause corrosion or other undesirable effects on neighboring structures. Further, that these adverse effects can be prevented, e.g., by connecting the neighboring structures to the protected one with wire bonds of proper resistance. Thus the bulletin stresses the need for cooperation among the structure owners so that these preventive measures can be properly engineered and applied.

Bulletin 1 also points out that where neighboring structures of two or more operators are subject to similar natural corrosion damage, "joint cathodic protection systems" can be designed, installed, and operated economically to the benefit and satisfaction of all concerned.

This Bulletin, No. 4 of the series, gives further information about these joint systems. It discusses the techniques of their design and installation, and possible division of responsibility for their construction, operation, and maintenance; and the sharing of costs. Also, it presents an outline of the principal points that may be included in any agreement between the structure owners.

The idea of joint cathodic protection is not unique. It follows the economically sound principles of the joint solution of local corrosion problems so well developed during the last three decades in metropolitan areas by "joint electrolysis committees".

The economy of joint cathodic protection on neighboring structures is evident. Let us assume that Operator A owns a line that traverses an area of corrosive soil, and that, aware of this fact, he decides to install cathodic protection on his line. Assume also that Operator B owns a neighboring line that is similarly threatened by natural corrosion, but that he has no such preventive measures in mind.

Suppose that A proceeds alone to protect his line. In this event, his impressed protective currents then may migrate into B's line and cause electrolytic corrosion at the points whence they leave to return into A's line. Sometimes this can be corrected by a change in the design of A's installation. Otherwise such correction may require, for example, bonding the two lines together with a wire of proper resistance. The installation of such a bond and the resultant use of additional current will increase A's costs without providing to B's line any substantial protection against natural corrosion.

Suppose that B, now also concerned about natural corrosion, decides to install cathodic protection independently on his line. His impressed currents in turn may adversely affect A's line unless other or different bonds are installed. Thus, where each party attempts an individual solution, installation costs and operating costs for both are increased. This causes economic waste.

Such a situation calls for joint cathodic protection at the outset. If A and B will jointly engineer, install, and operate such a system, both lines can be even more effectively protected. Furthermore, this can be accomplished with total capital and operating costs substantially less than the total costs of two individual systems, even if these were installed without regard to their mutual interference. By equitably sharing the joint costs, A and B both can enjoy maximum protection at minimum cost. This insures maximum economic gain.

While this Bulletin 4 does not treat cases where the protection of one structure affects conditions on a neighboring structure not requiring similar protection, such cases also are best dealt with by full cooperation and mutual appreciation of the problem. The need for these attitudes was made clear in Bulletin 1.

This bulletin will perhaps find its widest application in open country where the neighboring structures involved are continuous and cross infrequently. However, the same cooperative approach is even more desirable in developed areas having more complex structure layouts, which create more difficult technical problems.

This is Bulletin 4 of the series on cathodic protection prepared by the Correlating Committee on Cathodic Protection, sponsored by 11 organizations. Bulletin 1, "Management Information on Cathodic Protection," was published in *The Petroleum Engineer*, December, 1948; Bulletin 2, "Cathodic Protection Notification Procedures," February, 1950. Bulletin 3, "Technical Practices in Cathodic Protection," has not been completed.

Fundamentals of Joint System

The design of a joint cathodic protection system, including each subinstallation, should aim to give effective protection. Also, it should aim to do this as cheaply in capital and operating costs as is practicable considering all structures or lines involved. To accomplish this, several fundamentals should be kept in mind:

a. The engineer of each participating structure-owner should be the sole judge of his structure's own protection requirements.

b. Joint tests should be made to determine how much protective current each structure requires, taking into account the mutual reactions of all structures to such currents.

APPENDIX A

Record of Joint Cathodic Protection Installation

Description and location of installation:_____

_____

_____

_____

_____

Installed and Owned by:

_____

Agreed annual costs of installation effective from_____

_____ are as follows:

Fixed charges (__% of total capitalized cost of $_____) . . .	$_____
Fuel or electric energy costs	$_____
Other Operation and Maintenance costs . . .	$_____
Total agreed Annual Costs	$_____

Total Annual Costs are to be divided as follows:

_____ Company_____% . .	$_____
_____ Company_____% . .	$_____
Total	$_____

c. The wire bonding and anode system should be of ample size to handle the total current to all structures.

d. The total current should be divided among the structures in proportion to their needs.

Each of these design fundamentals is discussed briefly below.

A. *Judging requirements.* Different voltage and current conditions are required for proper protection of different types of structures; e.g., as between steel pipes and lead cables, between coated and uncoated pipes, between cables in ducts and buried cables, etc. Also, the techniques of testing for and prescribing such requirements are still being developed. Thus, different engineers may use different protection criteria. Joint studies and tests can proceed best when each participant's engineer is free to state and use his own criteria.

B. *Joint tests.* Different engineers will in many cases wish to use different testing techniques and instruments. Because the changes in potentials of and currents in the various structures are interdependent, however, any tests made by individual participants must be coordinated into a joint result. This usually can be effected informally by the engineers.

C. *Overall design.* The coordinated result of the joint tests will indicate how much current should flow to each structure, and the effective resistance presented by each to such current. After the individual requirements are known, the total protective current demand can be found. Then, based on test data, the anode structure can be designed. The operating voltage of the rectifier or generator must be ample to impress the total protective current through the resistance of the entire electrical network. In most cases both the current and voltage outputs of the rectifier or generator should have some margin for contingencies.

D. *Dividing current among structures.* The total current can be distributed by adjusting the resistances of the leads from the rectifier or generator to the several structures. These resistances can be estimated from the initial test data, but because of environment changes after the installation has been in operation for some time, subsequent adjustments usually must be made. Tests are desirable from time to time to ascertain that all needed protection is afforded.

When further studies of the techniques of cathodic protection are made and reported on, and as more experience is gained with joint installations, the prevalent variations in testing technique and protection criteria should be reconciled, thus simplifying cooperative design.

Responsibility and Costs

With joint protection installations it has proved most practical for one participant to own and maintain the rectifier or generator, the anode structure and all other equipment common to all protected structures. Conversely, each participant preferably should own and maintain the wires, connections, etc., serving only its own structure.

The participants that can most readily and efficiently do the job should normally build, own, and maintain the common parts of the installation. A fair division of the common initial, fixed, maintenance, and power costs must be worked out among all participants, however. Although conditions will vary widely, in each case such fair division among them can be determined by analysis of the equities.

The agreed arrangement for division of costs should be flexible enough to accommodate later desirable changes in total protective current or current distribution. In some cases such flexibility has been promoted by agreement of the participants to share the annual costs equally rather than to recompute such costs with each minor change in plant or current use. In other cases the participants have agreed to share such costs on the basis of distribution of current flow. For clarity, those two arrangements are recited more concisely; viz:

a. The sum of the annual (actual or estimated) fixed, maintenance, and power costs of the joint installation will be divided equally among the participants.

b. The sum of the annual (actual or estimated) fixed, maintenance, and power costs of the joint installation will be divided among the participants in proportion to the protective current flowing to each structure.

A compromise between these two arrangements is a third possibility for division of costs.

Agreements

Before the testing and the installation work is begun, the participants should agree on the responsibilities of each. Generally such an agreement is reached informally on the basis that each should do his fair share. To confirm the arrangement for division of annual costs, some more formal agreement is advisable. In many cases this can be handled by an interchange of letters or by jointly prepared memoranda recording the result of conferences.

If a general agreement seems desirable, it may include any or all of the following provisions:

1. If either party contemplates installation of cathodic protection equipment on its underground structures in any area in which the other party also owns underground structures, it should invite the other party to join in a cooperative study of the common problem.

2. If such a study is agreed upon, both parties should cooperate in the necessary surveys, and the preparation of plans and estimates, and then decide whether or not to install and

operate joint cathodic protection facilities for their common benefit.

3. If it is decided to install and operate such facilities, the parties should agree as to which of them shall build, own, operate, and maintain the proposed joint installation. (In general this should be the one which, under the circumstances, can perform the services at the lowest cost.) The parties should agree also on an equitable division of the annual costs, including fixed charges and operation and maintenance expenses, of operating such installation, taking into consideration estimates of annual costs, results of field tests, and any other pertinent matters.

4. The party to make the joint installation should then do so in accordance with the jointly approved plan. When the installation is completed, field tests and adjustments should be made to the mutual satisfaction of both parties.

5. An arrangement should be made for billing the costs of operation at suitable intervals.

6. A record of each joint installation should be made a part of the agreement. Appendix A indicates the data pertinent to such a record. * *

Service Pipe Line Announces Promotions

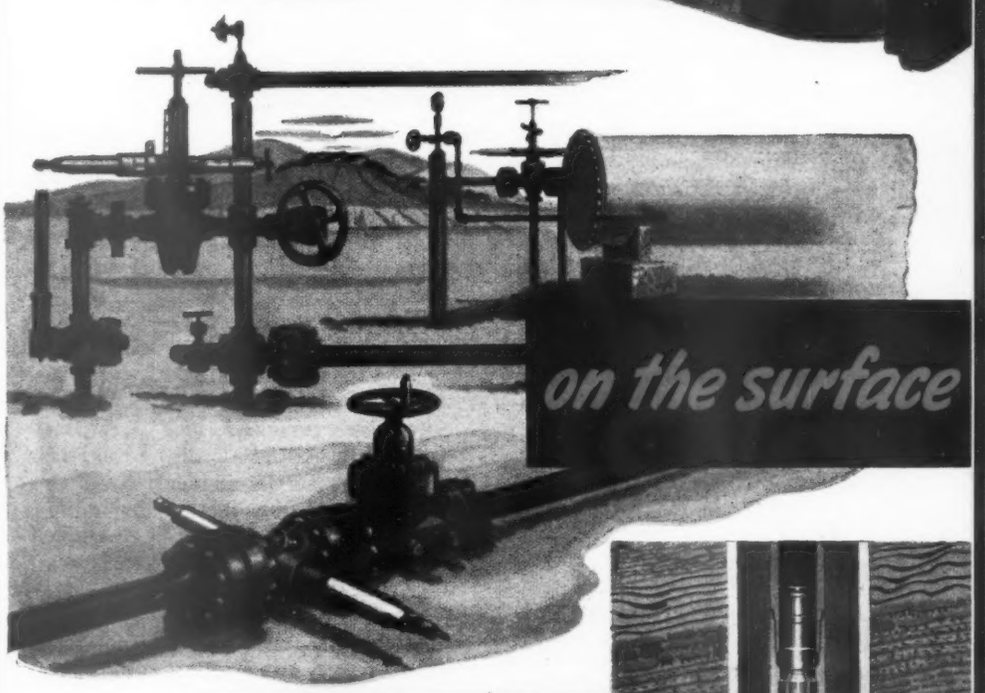
Service Pipe Line Company's board of directors has elected two vice presidents and appointed a new general manager, President J. L. Burke announces.

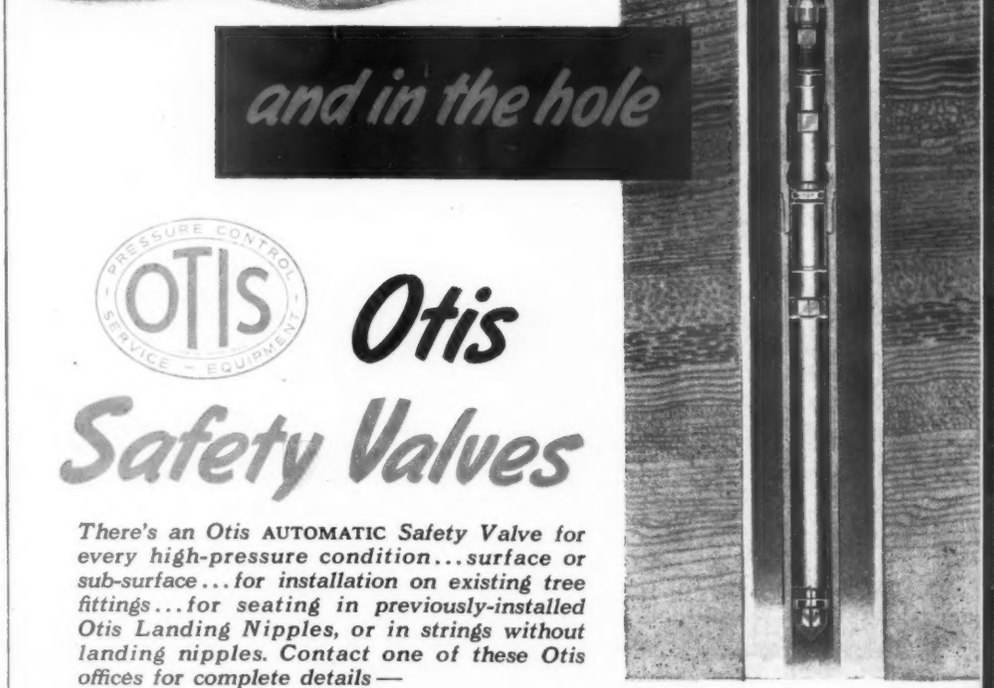
J. R. Polston, former general manager, was elected vice president-operations. R. J. Andress, former director in charge of traffic, was elected vice president-traffic. C. M. Scott, Jr., former assistant general manager, became general manager.

Polston joined the company in 1922 as a draftsman. Resigning in 1926, he was employed by Marland Oil Company and Arthur G. McKee Company as a refinery process and design engineer. He returned in 1934 and his advance since that time has been rapid.

Andress, a transportation law specialist, joined the company in September, 1946, on separation from the army. In 1948, he was elected to the company's board of directors.

Scott, a board member since 1946, joined the company in 1916 as an engineer-draftsman when it was known as Sinclair-Cudahy Pipe Line Company. During his uninterrupted period of service he has served as the company's assistant chief engineer and chief engineer. In various capacities with the company, he has actively participated in the design and construction of the system for 33 years.





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NEWS

Service Is Increasing Capacity from Ranger

Service Pipe Line Company has purchased from the O. R. Burden Construction Company, 48 miles of 8-in. pipe formerly owned by The Texas Company between Ranger and Weatherford, F. M. Willenburg, East Texas division manager, announces.

Connection Foremen W. H. Cook and F. C. Deitemeyer and their crews, under the supervision of District Superintendent R. R. McAnear are reconditioning the line, which has been in the ground since 1919.

SPLCo. will put the old line in use by constructing approximately 7½ miles of 8-in. line to connect the west end of the system with its Ranger station, and tying the east end into the SPLCo. system between Mexia and Graford near Weatherford.

Vaughn and Taylor Construction Company, of Wichita Falls, contractor, is making the 7½-mile connection.

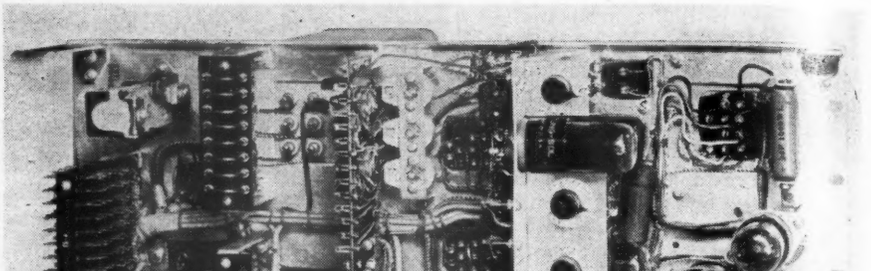
By using this stretch of reconditioned line and with the installation of additional pumping equipment at Ranger station, Services crude oil outlet capacity from the Ranger area will be approximately 42,000 bbl a day, Willenburg said, which is about double the present outlet.

Willenburg said the company plans to install four 220-hp LeRoi gas engines at the station, which presently is equipped with a 300-hp diesel engine. Installation will be by SPLCo. crews. Ranger station is under the supervision of E. D. White, chief station engineer.

To handle this increased quantity of crude, Service is installing booster pumps between working tanks and pumping units instead of increasing the size of suction lines.

At the present time oil is being gathered and delivered to Service at Ranger station by Humble Pipe Line Company, and Premier Pipe Line Company. Some oil from this area is pumped by Premier through its line to a connection with SPLCo. lines near Weatherford and thence to SPLCo.'s Graford station for movement north and east.

The 48 miles of pipe line that SPLCo. is reconditioning between Ranger and Weatherford is one segment of a line the Burden Construction Company bought for salvage from The Texas Company. The 8-in. line continues eastward from Weatherford to Fort Worth and Dallas. Service has arranged to purchse from Burden all usable pipe that is salvaged from the remainder of the line.



FTR 9-H-2 medium-haul carrier telephone system.

Texas Gas Completes Construction Program

Texas Gas Transmission Corporation is increasing its daily natural gas deliveries by 60,000,000 cu ft. Officials of the company said the increase is made possible by completion of a compressor station construction program begun several months ago.

The addition to delivery capacity is sufficient to take care of increased heating needs during cold weather in the company's service area, W. T. Stevenson, executive vice president, explained. The 2400-mile Texas Gas system now serves residential and industrial customers in the Mississippi and Ohio River areas with over 700 million cubic feet of gas a day.

Earlier this month Texas Gas announced a $42.3 million pipe line construction program designed to meet increasing wartime emergency needs for natural gas of plants and labor forces devoted to the production of military material. This program, calling for the construction of 580 miles of large diameter pipe line, would raise the company's daily deliveries by 200 million cubic feet to 900 million cubic feet daily.

As a result of this announcement, Stevenson reported, Texas Gas can, under present conditions, meet the peak-day heating demands of utility customers in Louisiana, Arkansas, Mississippi, Kentucky, Indiana, and eastern Illinois.

In addition, during off-peak days on its own system, Texas Gas can deliver portions of the 60 million cubic feet additional capacity at the northern terminus of its pipe line for the use of Columbia Gas System and Consolidated Natural Gas Corporation subsidiaries. These subsidiaries serve utilities in Ohio, Pennsylvania and West Virginia.

This arrangement will enable Texas Gas to operate its system at a higher load factor during the entire year.

The Texas Gas compressor station construction program included the building of a new 4,500 horsepower station at Hardinsburg, Kentucky, and the addition of 5,460 horsepower at four existing stations located at Slaughters and Calvert City, Kentucky, and Kenton and Covington, Tennessee. The cost of the project was over two million dollars.

Medium-haul Carrier Telephone System

To meet the need of organizations requiring a greater number of telephone channels over moderately long lines, Federal Telephone and Radio Corporation, Clifton, New Jersey, manufacturing associate of the International Telephone and Telegraph Corporation, has developed a medium-haul carrier telephone system known as the FTR 9-H-2. This system, which is stackable to three channels, will operate on open telephone wire over distances ranging up to 225 miles.

The new equipment is designed principally for independent telephone companies, utilities, railroads, and pipe line companies for operation over distances where the more expensive long-haul system would be economically impractical.

The 9-H-2 carrier system employs single-sideband transmission and operates at frequencies that are coordinated with those of other carrier telephone systems. The signal receiving circuit of the 9-H-2 system has been specially designed to make it less sensitive to pulse ratio variations, and a new pulse ratio adjustment has been incorporated to permit optimum pulsing. Each of the three channel terminals can be installed in only 8¾ in. of rack space.

Report Made on Operations Interprovincial Pipe Line

Interprovincial Pipe Line Company's vice president, T. S. Johnston, has reported on initial operating studies. Only a partial study of corrosive conditions has been made, but definite "hot spots" have been indicated and cathodic protection provided for the line at these points. The program will be expanded when more information has been secured.

Leduc field crude is being segregated and handled separately on account of its special lubricant qualities, which bring a price differential. Other Edmonton area crudes are being pumped as common stream oil. Contamination has been kept to a minimum, as indicated by experience with the first movement of Leduc crude. On 113,000 bbl from Edmonton to Regina, contamination was less than 1 per cent, about 1000 bbl. Expectation is that this ratio will be cut in half when all stations are in operation and pressures can be maintained more nearly constant. Johnston confirmed the decision to build six new pump stations to raise the total number to 12, which will increase capacity to 135,000 bbl per day out of Edmonton from the present 95,000 bbl. Station spacing will be about 100 miles when the stations are completed, which is considered the ideal distance for the relatively flat terrain.

Pump equipment is standard for each station. Four diesel engines, of 1080 and 850 hp, are installed with three in continuous operation and one as a standby, connected through a speed increaser to the centrifugal pumps. The climatic conditions that affect Great Lakes navigation during about four months of the year when tankers cannot move through the ice are believed unique in effect on the pipe line operation. This necessitates a variation in end delivery schedules at Superior, Wisconsin, terminus from 10,000 bbl per day in winter to 50,000 bbl in summer and consequent large storage tank capacity at both ends: Input storage of 840,000 bbl and terminus storage (by next summer) of 4,400,000.—L. O. R.

Platte Pipe Line Awards Contracts

Platte Pipe Line Company, which has undertaken the construction of a 20-in. crude line from Wyoming to Wood River-St. Louis area, has awarded construction contracts aggregating nearly $8,500,000 for the full length of the line, 1072 miles. In addition to these awards, it is estimated that the contractors will receive approximately $650,000 for rock excavation and $1,500,000 for extra services, or a total of about $10,500,000, exclusive of the cost of two river crossings. Estimated cost of the entire project is $60,000,000.

Participating in this undertaking are: British American Oil Company, Ltd., Continental Oil Company, The Ohio Oil Company, The Pure Oil Company, and Sinclair Refining Company. All companies have production in Wyoming and the Rocky Mountain area, and upon completion of the new line it is estimated that it will provide a market above local refinery requirements for about 90,000 bbl a day. The line is so routed that practically all pipe lines in Wyoming can be connected with it.

Contract for about half of the line, extending from Charham Station, Wyoming, to Brule, Nebraska, was awarded to R. H. Fulton and Company, Lubbock, Texas. Bishop and Lock Construction Company, Dallas, Texas; Rumsey Brothers Pipe Line Construction Company, Houston, Texas, and O. R. Burden Construction Company, of Tulsa, Oklahoma, were awarded contracts for the remaining sections of the line, extending to the Mississippi River.

Work is expected to get under way about March 15.

Great Lakes Completes Another New Segment

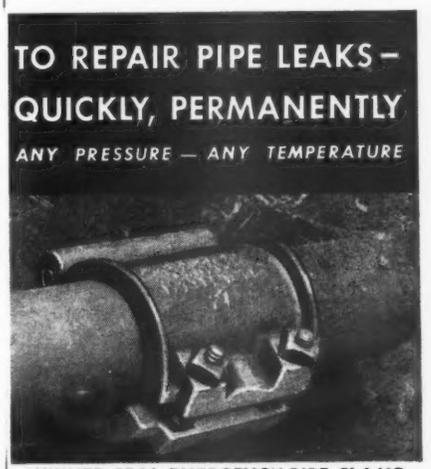
Completion of a second 12-in. line between Barnsdall, Oklahoma, and Kansas City, Kansas, has been announced by Great Lakes Pipe Line Company officials.

This latest section brings to 1300 miles the total of 12-in. lines, all parallel to other lines, constructed in the carrier's expansion program. In addition it recently placed in operation 44 miles of 8-in. line.

The 12-in. lines originate at Ponca City and Tulsa, Oklahoma, and follow the same route from Barnsdall to Kansas City where they divide with one line terminating at Minneapolis, the other at Sioux Falls, South Dakota.

The second 12-in. from Barnsdall provides matching capacity into and out of Kansas City, with the lines operating on 100-mile station spacing.

Company officials said the previous increase in capacity provided by the new construction has enabled the carrier to keep abreast of distillate nominations made by its shippers, and to lower the backlog of gasoline offerings. The further capacity increase provided by the second 12-in. line will enable the carrier to become current with gasoline nominations in the last half of February.



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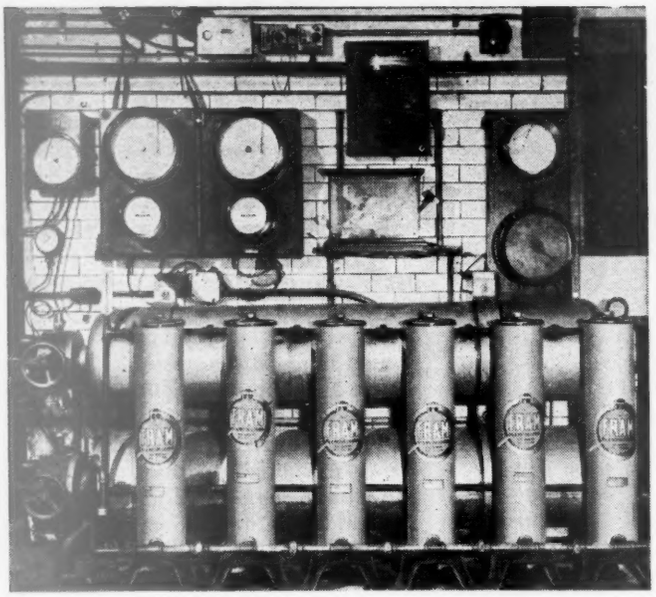

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Underground Storage Program for Texas Gas

Texas Gas Transmission Corporation announces that it is embarking on a $939,000 underground gas storage program to meet the constantly expanding demands for natural gas in its midwestern service area.

The long-distance transmission company, which recently announced a $42,300,000 pipe line expansion program to meet the needs of its customers and of defense production, asked the Federal Power Commission to authorize the development of the Alford underground storage field near Petersburg, Indiana, which would enable Texas Gas to supplement its peak deliveries of natural gas by 30,000,000 cu ft a day.

When completed, the Alford storage field will hold 4,000,000,000 cu ft of gas. Texas Gas now operates a storage field at Oaktown, Indiana, capable of delivering 6,000,000 cu ft a day. Additional storage plans, the company said, will be announced in the future.

To develop and utilize the Alford field, Texas Gas said, it will be necessary to:

1. Construct 12 miles of lateral pipe line from the company's pipe line system in Indiana to the Alford field.
2. Construct 4.5 miles of storage field lines.
3. Construct a measuring station to record the amounts of gas delivered and withdrawn from the Alford field.
4. Construct a 1200-hp compressor station to pump gas into or out of the field.

The company said it would store gas during summer months for use during cold weather periods, thus helping Texas Gas meet increased demands along its 2400-mile pipe line system. In addition, Texas Gas noted, storage of gas during the summer will allow the company's present lines and supply points to be operated at higher load factors throughout the year, and will permit greater flexibility of pipe line operations to meet peak demands.

Work on the Alford Storage project can begin about March 1, the company said, so that necessary construction work may be completed and gas injected during the summer.

Equitable Gas Would Acquire Subsidiary

The Federal Power Commission has been asked to authorize the acquisition by Equitable Gas Company of the natural gas facilities of its subsidiary, Pittsburgh and West Virginia Gas Company. Both companies have main offices in Pittsburgh.

The joint application filed by the two companies says that their facilities are interconnected and integrated and are operated as a unified part of the Equitable Gas System. The proposed acquisition would eliminate the necessity of maintaining Pittsburgh as a separate corporation, thus permitting a reduction in operating expenses and the simplification of accounting procedures, the application says.

Pittsburgh operates wholly within West Virginia, and is engaged in the purchase, production, transmission, storage, distribution, and sale of natural gas. The bulk of the gas that it purchases and produces is sold and delivered at the West Virginia-Pennsylvania state line to Equitable. Pittsburgh serves more than 8000 customers in West Virginia, principally in Grafton and Shinnston.

Equitable's operations are confined to Pennsylvania, where it purchases, produces, transmits, stores, distributes, and sells natural gas. It serves over 212,000 customers, principally in the Pittsburgh area.

After necessary regulatory authority has been obtained, it is proposed that Pittsburgh and West Virginia Gas Company will be dissolved, with its assets and properties to be distributed in complete liquidation to Equitable, the sole stockholder of Pittsburgh. The capital stock of Pittsburgh will then be cancelled and redeemed.

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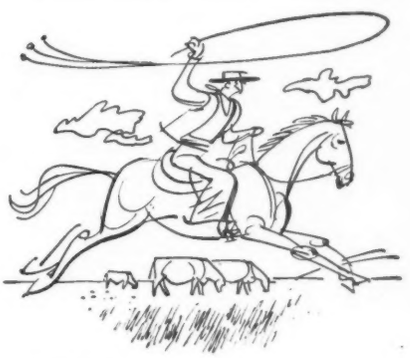
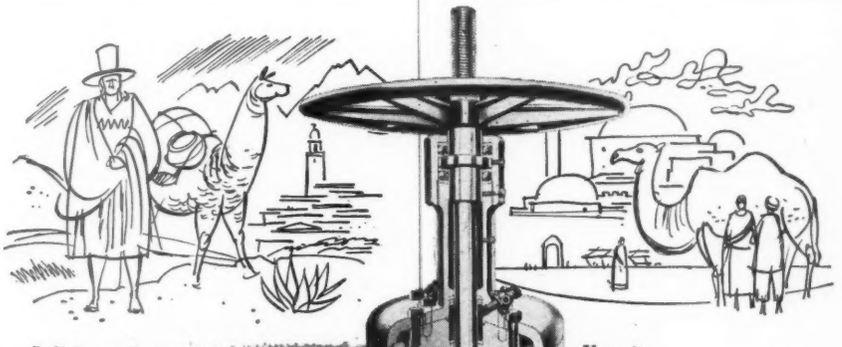


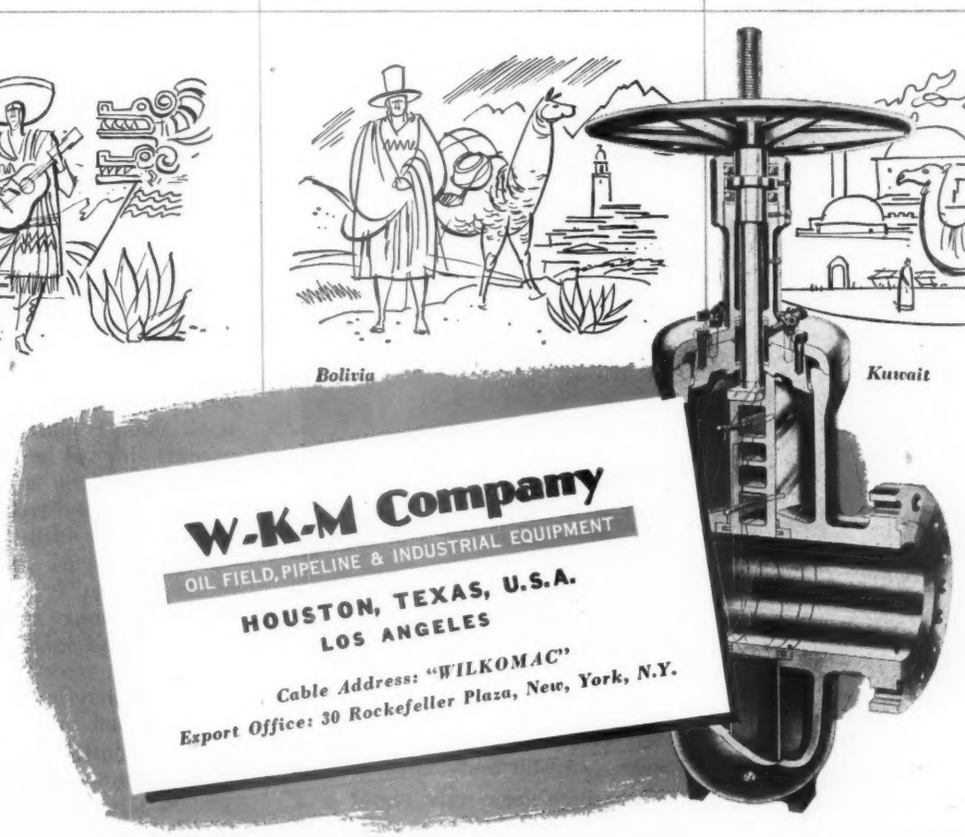
Argentina

Mexico



Bolivia

Kuwait



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MAP OF SINCLAIR PIPE LINE SYSTEM
LEGEND
WHOLLY OWNED
PARTIALLY OWNED
STATIONS
TERMINALS (SALES)
SINCLAIR REFINERIES
SINCLAIR PRODUCTS SYSTEM
SINCLAIR CRUDE SYSTEM
PENNSYLVANIA
NEW JERSEY
DELAWARE
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
ALABAMA
FLORIDA
TENNESSEE
KENTUCKY
INDIANA
ILLINOIS
MISSOURI
ARKANSAS
LOUISIANA
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NEBRASKA
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MINNESOTA
IOWA
WELLSVILLE
TOLEDO
CLEVELAND
COLUMBUS
ZIESTROY
EAST CHICAGO
MILWAUKEE
PERU
ROCKFORD
WOOD RIVER
MINNEAPOLIS
HANNATO
FORT DODGE
GREAT LAKES PIPE LINE CO
KANSAS CITY
INDEPENDENCE
TULSA
OMAHA
SIOUX FALLS
WATERTOWN
GRAND FORKS
FT WORTH
DALLAS
TROUP
HOUSTON
AUSTIN
SAN ANTONIO
CORPUS CHRISTI
SALT CREEK
CASPER
SINCLAIR
SAND DRAW

R. J. Tibbets, left, president, Sinclair Pipe Line Company, is congratulated by P. C. Spencer, president of Sinclair Oil Corporation.

Sinclair Pipe Line Company Formed

MAP ON OPPOSITE PAGE

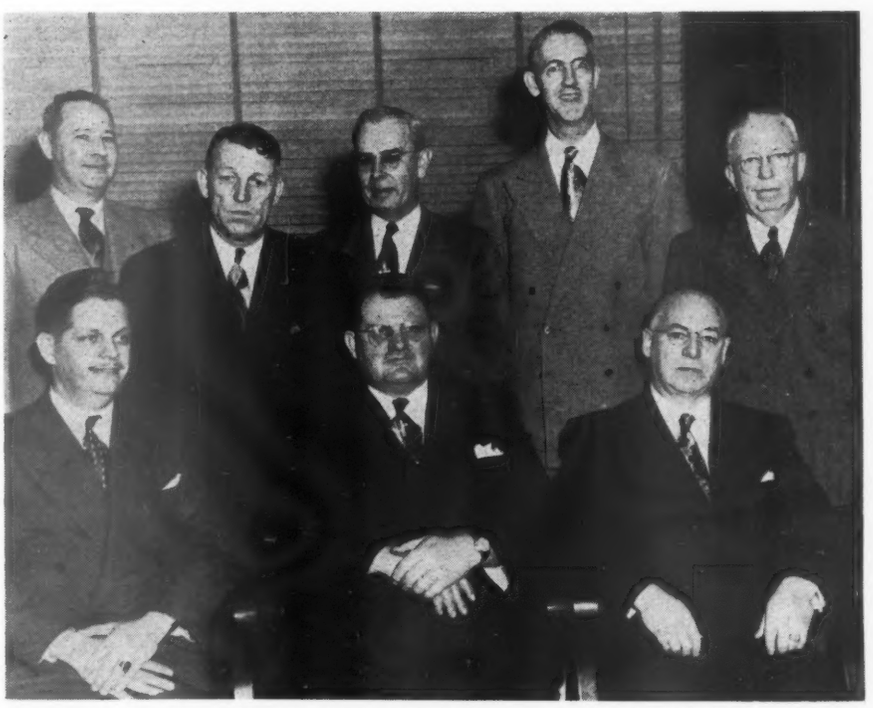
At a special press conference and celebration in Independence, Kansas, during January, P. C. Spencer, president of Sinclair Oil Corporation, announced the formation of the Sinclair Pipe Line Company, a $100,000,000 subsidiary to take over all pipe line properties and operations of the Sinclair companies. At the first directors meeting, officers were elected and transfer of all Sinclair crude oil and products to the new company was completed. More than 12,000 documents were required for this transaction. At a later date, it is contemplated that Sinclair's part-interest in other pipe lines also will be transferred to the new company. These include the Texas-New Mexico Pipe Line Company, Platte Pipe Line Company, Great Lakes Pipe Line Company, and Basin Pipe Line System.

At the same conference, Spencer announced that plans had been approved for the construction of a 22-in. crude oil line from Drumright, Oklahoma, to Chicago, Illinois, a distance of approximately 700 miles. This line, with six pump stations, will cost approximately $48,000,000 to build. Its capacity with that number of stations will be 145,000 bbl a day.

Additional refinery requirements in the Wood River and East Chicago areas have made the new line necessary, Spencer explained. It will replace multiple smaller lines now in existence, resulting in substantial economies in the operation and maintenance of the system. Reduction in maintenance costs and increased operating efficiency will pay the cost of the new line in a limited period of years, Spencer stated.

The Sinclair pipe line system, formerly operated as a department of Sinclair Refining Company, consists of 5084 miles of crude trunk lines, 5576 miles of crude gathering lines, and 2835 miles of products lines, extending from the Atlantic Coast via Chicago to Houston, Texas, a total of 13,495 miles. Last year the lines dedelivered approximately 125,000,000 bbl of crude oil and refined products.

Officers of the new Sinclair Pipe Line Company are as follows: R. J. Tibbets, president and director; W. H. Morris, L. B. Moon, and A. M. Stafford, vice presidents and directors; R. C. Beardon and Charles Fitzgerald, vice presidents; J. P. Main, secretary and treasurer; H. T. Wint, assistant secretary and assistant treasurer; W. H. McBrayer, counsel, and A. Moffit, auditor. * * *



Officers of the new Sinclair Pipe Line Company: Seated, W. H. Morris, vice president and director; R. J. Tibbets, president and director; A. M. Stafford, vice president and director; standing, L. T. Wint, assistant secretary-treasurer; L. B. Moon, vice president and director; John P. Main, secretary-treasurer; R. C. Beardon, vice president; and Charles Fitzgerald, vice president.

PIPELINE PERSONALS

Charles Dunlap, former area industrial relations supervisor in West Texas for the Service Pipe Line Company, has been transferred to the Illinois-Missouri division in the same capacity, **J. R. Polston,** general manager, said at Tulsa, recently.

He will make his headquarters in Tulsa and maintain an office in the Galesburg division headquarters. **J. J. Willenburg,** Illinois division manager, said Dunlap had been assigned to assist him in industrial relations work and also to aid **H. G. Mariner,** Missouri division manager.

Dunlap, born in 1904 at Holland, Texas, joined Service Pipe Line Company in 1931. Earlier he was employed by the Santa Fe railway as a machinist apprentice and timekeeper and by commercial firms in Tyler, Texas. In 1937 Dunlap worked at Odessa, Missouri as a station gauger and in 1942 he was transferred to Hufsmith, Texas, as a station engineer. Since June, 1949 he has worked as an area industrial relations supervisor.

Paul E. Carrithers, Forth Worth, Texas, Service Pipe Line Company's area industrial relations supervisor for East Texas, temporarily will assume Dunlap's West Texas duties in addition to his East Texas duties, Polston said.

E. J. Wacker, who has been assistant chief mechanical engineer at Magnolia Pipe Line Company's offices in Dallas, Texas, has been promoted to assistant division superintendent of the Western division with headquarters at Midland, Texas.

C. S. Cone has been promoted to chief accountant of Magnolia Pipe Line Company to succeed **J. B. Morgan** who retired January 1. **J. G. Meredith** succeeded Cone as assistant chief accountant.

Roland McDonald has been promoted to district superintendent of the Southwest Texas district with headquarters at Alice, Texas. He succeeded **H. C. Alton,** who retired January 1.

J. S. Black has been promoted from district foreman to assistant district superintendent of the West Texas district with headquarters at Snyder, Texas.

F. D. Roesler has been promoted to chief clerk of the North Texas district with headquarters at Wichita Falls, Texas. He succeeded **F. M. Baker** who retired January 1.

L. H. Kindig has been elected assistant treasurer and **S. M. Sweeney** cashier for Cities Service Oil Company (Del.) and Cities Service Pipe Line Company, **L. A. Lynd,** vice president and treasurer, announces.

Kindig is a 26-year man with Cities Service, having joined a Cities Service utility company in 1924 as a budget department employee. In 1929, he was transferred to Cleveland as assistant secretary of Cities Service Oil Company of Cleveland, a position he held for seven years. He was then transferred to Bartlesville where he was a member of the federal tax department. A transfer to the treasurer's division came earlier this year.

Sweeney has served the company at Bartlesville for 31 years, starting work in the secetary's division. He was transferred to the treasurer's division in 1923 and assigned to the cashier's department. His appointment as assistant cashier came in 1940, a position he has held since.

Harry Nelson, Cities Service Pipe Line Company, Bartlesville, Oklahoma, and **J. N. McClure,** The Elliott Company, Tulsa, recently became members of The Pipe Liners Club of Tulsa.

E. W. Jenkins, superintendent of Shell's northern district pipe lines with headquarters at Corral, near Tracy, has retired after nearly 35 years with Shell **W. C. Roberts,** pipe line division manager, Los Angeles, has announced.

F. B. Jensen, superintendent of the southern district pipe lines, succeeds Jenkins at Tracy. Jensen joined Shell in 1926 as a rodman and after gaining wide experience in pipe line operations was appointed superintendent of the southern district pipe lines in 1947, moving from there to Corral.

H. H. McQueen succeeds Jensen as superintendent of the southern district pipe lines with headquarters in Los Angeles. McQueen joined Shell in 1926 as a draftsman. He was made senior mechanical engineer in Los Angeles in 1944, which position he has held until the present promotion.

T. W. Belt, senior engineer from the Wilson district, Oklahoma, has been loaned by Interstate Oil Pipe Line Company to Trans-Arabian Pipe Line Company for from three to six months, during which he will supervise an inventory and valuation of Tapline. Other employees recently loaned to Trans-Arabian are **O. E. Ritter,** district gauger from Illinois; **T. H. Burden,** station engineer, also from Illinois, and **John T. Williams,** pipeliner from the Wewoka district, Oklahoma.

Laurence Andrew

Laurence Andrew, manager of the pipe line department of the General Petroleum Corporation, retired on January 1 after 38 years' service with the company.

Andrew joined General Petroleum in 1912 when the company's pipe line was being built from the San Joaquin Valley to Los Angeles—a major engineering feat of the day. His first post was as division superintendent. He has been manager of pipe lines since January, 1950.

Also retired January 1 was **Richard A. Brooks,** assistant treasurer and assistant comptroller of the company; **Thomas R. Evans,** chief pipe line dispatcher, and **R. C. Jones,** superintendent of engineers in the marine department.

Brooks joined a General Petroleum affiliate in Mexico in 1921 and went to work for General Petroleum in Vernon, California, in 1923. He was chief accountant and manager of the accounting department previous to becoming assistant comptroller in 1943 and assistant treasurer in 1949.

Evans' service with General Petroleum begun in April, 1913, when he was employed as a telegraph operator. He has been chief dispatcher since 1926.

Jones joined General Petroleum in 1922 as an assistant port engineer at the then-new General Petroleum marine terminal on Terminal Island. He became port engineer in 1924 and has been superintendent of engineers since 1925.

All four of the General Petroleum men retire under the company's annuity plan, which dates back to 1912.

J. R. Wright has been transferred to Houston, Texas, as district superintendent of the Houston and Beaumont districts of Magnolia Pipe Line Company. Wright replaces J. H. Joy, who passed away recently.

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PIPE LINE PROJECTS

Gulf Plans West Texas-Gulf Coast Line

Officials of Gulf Oil Corporation announce that plans have been filed with Petroleum Defense Authorities in Washington for the construction of a 26-in. diam crude oil pipe line extending from the West Texas producing area to refineries on the Gulf Coast.

Associated with Gulf are four other oil companies — Cities Service, Pure Oil, Sun Oil, and Standard of Ohio. Estimated main line capacity will be 300,000 bbl a day. The line will be 440 miles long and will have a connection in eastern Texas to northbound crude lines serving refineries in the Ohio Valley and Great Lakes region.

Construction is contemplated to begin in late summer or early fall of this year with completion early in 1952.

The new line will provide urgently needed additional pipe line capacity to serve the great West Texas producing area, which is the largest in the country and which recently has been further increased by extensive new discoveries in Scurry and Kent counties. The pipe line also will assure expanding supplies of crude oil to established refineries to meet the growing requirements for petroleum products due to the national emergency.

The new project accomplishes the greatest possible efficiency in the use of steel, which is a very important factor at this time when the need for steel is so great. It will also release a large mileage of smaller diameter pipe lines, which, although inefficient in their present use, can be utilized to great advantage in other services including shipment of refined products. Pipe for the new project is scheduled for delivery later this year and if all other needed materials are obtained the project can be completed in a relatively short time.

Offshore Project Planned by United Gas Pipe Line

United Gas Pipe Line Company, Shreveport, Louisiana, has applied to the Federal Power Commission for authority to construct and operate natural gas facilities in the offshore fields in the Gulf of Mexico off the coast of Louisiana.

The company is proposing to build about 12.3 miles of 14-in. line extending from the Pure Oil Company's platform southwest to a platform operated by Magnolia Petroleum Company, Continental Oil Company, and Newmont Oil Company. A second section of line, 10 in. in diam, approximately 14.4 miles long, would extend from the latter point south to another platform operated by Magnolia, Continental, and Newmont.

United said that under terms of its contract with Magnolia, United is not required to construct the 14.4-mile portion of line until the demonstrated reserves in Magnolia's offshore fields are one trillion cubic feet or more. If Magnolia builds the line and it is later determined that the reserves exceed one trillion cubic feet, then United will seek authority to acquire the line, the application states.

United has another application pending before the commission seeking authority to construct a line extending into the Gulf of Mexico as far as the Pure Oil Company's platform. The company's new application proposes to extend this line to receive gas from Magnolia and its associates.

Estimated cost of the 12.3-mile section of line is $1,279,657, and the 14.4-mile portion is estimated to cost $1,222,455—a total of $2,502,112.

Equitable Gas Would Build New Station

Equitable Gas Company, Pittsburgh, Pennsylvania, has filed an application with the Federal Power Commission for authorization to construct a new compressor station in Washington County, Pennsylvania, to help meet increasing demands.

The project, estimated to cost about $1,045,000, would include a new compressor station consisting of 3 gas-engine-driven 1100-hp compressor units and connecting pipe lines, a glycol dehydration plant, gas scrubbers, etc.

The company said the new station would replace an existing station used for compression of gas into Equitable's Finleyville, Tepe, and Bunola storage pools. Purpose of the new facilities is to increase pressure in the Bunola pool by pumping up to a maximum capacity of 13,000,000,000 cu ft of gas into storage, thus creating a daily delivery capacity of approximately 80,000,000 cu ft daily.

Transco Plans Auxiliary Connection to New York

Presiding Examiner Emery J. Woodall of the Federal Power Commission has filed an initial decision, subject to review by the commission, authorizing Transcontinental Gas Pipe Line Corporation, Houston, Texas, to construct an extension of its main pipe line to provide an auxiliary connection for delivery of natural gas to the New York Metropolitan area. Estimated cost is $4,189,252.

The new segment of line, to be about 11 miles long, would extend from a point on Transcontinental's Texas-to-New York City line near East Carteret, New Jersey, to the Bay Ridge section of Brooklyn. The exact length and details of the line depend upon final survey and purchase of rights-of-way.

Examiner Woodall said that at the present time there is a single underwater crossing of the Hudson River to Manhattan at 134th Street, with a single main extending from this delivery point through Manhattan, across the Harlem River, through a portion of the Bronx, and across the East River to Astoria, Queens.

As a break at any point on the mains would cause almost immediate failure of the natural gas supply to these New York companies, the examiner continued, the existence of the alternate route would provide far greater security of supply during any such emergency.

FPC Orders Trinidad, Colorado, Be Supplied

The Federal Power Commission has ordered Colorado Interstate Gas Company, of Colorado Springs, Colorado, to connect its pipe line facilities with those proposed to be built by the City of Trinidad, Colorado, and to deliver and sell up to 1,000,000 cu ft of natural gas a day for local distribution in Trinidad.

The city will build a 35-mile pipe line extending from the proposed point of interconnection on Colorado Interstate's Panhandle - Denver transmission line to a distribution system to be built in Trinidad. Estimated construction cost of the transmission and distribution facilities is $1,100,000. An artificial gas distribution system which previously served the city was abandoned in January, 1950.

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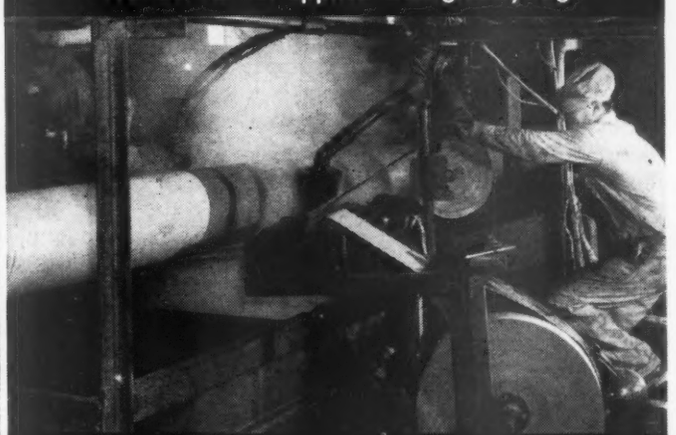
NO-OX-ID hot applied with granny rag

NO-OX-ID applied by traveliner



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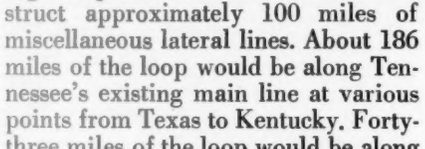
Tennessee Gas Asks Another Expansion

Tennessee Gas Transmission Company, Houston, Texas, has filed an application with the Federal Power Commission for authorization to construct pipe line facilities designed to increase the design delivery capacity of its transmission system by about 45,000,000 cu ft of natural gas a day, to be delivered to Iroquois Gas Corporation, United Natural Gas Company, and Equitable Gas Company.

Tennessee is proposing to build a total of 253 miles of loop line; to install approximately 61,000 hp in existing compressor stations, and to construct approximately 100 miles of miscellaneous lateral lines. About 186 miles of the loop would be along Tennessee's existing main line at various points from Texas to Kentucky. Forty-three miles of the loop would be along the company's Buffalo extension.

Estimated cost of the project is $36,241,000. Iroquois, United, and Equitable, which now receive gas from Tennessee, each has exercised its option for an additional 15,000,000 cu ft of natural gas a day, the application says. Iroquois has its main office in Buffalo; United, in Oil City, Pennsylvania, and Equitable, in Pittsburgh, Pennsylvania.



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Northeastern Applies for Extended Facilities

Northeastern Gas Transmission Company, of Springfield, Massachusetts, has applied to the Federal Power Commission for authority to extend its presently authorized pipe line system to provide natural gas service to all of the New England towns and communities that Algonquin Gas Transmission Company, of Boston, Massachusetts, proposes to serve, and to a number of additional communities in Massachusetts, eastern New Hampshire, and Maine.

The commission on November 8 authorized Northeastern to supply part of the New England area with natural gas and stated that the balance of the markets should be served by Algonquin upon a showing that it has an adequate supply of gas.

The Northeastern project as now authorized includes a total of about 511 miles of pipe line in Massachusetts, Connecticut, and New Hampshire. Algonquin is proposing to serve other markets in Massachusetts and Connecticut as well as in Rhode Island.

The new Northeastern application proposes the construction of approximately 441 miles of additional lines and an 8000-hp compressor station at an estimated cost of $14,029,224. Northeastern said that the proposed integrated system would have a delivery capacity of approximately 414,000,000 cu ft daily and would be capable of delivering about 500,000,000 cu ft a day under peak load conditions when fully powered and with winter-flowing temperatures.

The application says that Tennessee Gas Transmission Company, of Houston, Texas, Northeastern's parent, will file an application for authority to construct facilities necessary to deliver a total of 350,000,000 cu ft of gas a day to Northeastern. Tennessee is presently authorized to supply 156,000,000 cu ft daily to Northeastern, with Transcontinental Gas Pipe Line Corporation, also of Houston, authorized to supply 64,000,000 cu ft a day.

Northeastern concurrently filed a petition asking the FPC to amend its November 8 order by approving the substitution of 24-in. line for the 20-in. line previously authorized on the 144 miles of the main system in Massachusetts. This main line originates at the New York-Massachusetts state line near Pittsfield, Massachusetts, and extends to a terminus near Boston. The company also is proposing substitution of larger sized pipe on several laterals in order to balance the system and to assure adequate service to customers.

Editor's Note: Just before going to press word was received that FPC had dismissed the application without prejudice insofar as it relates to serving markets that Algonquin is proposing to serve. This leaves the way open for refiling should Algonquin's pending application be denied.

El Paso Natural Seeks to Expand

El Paso Natural Gas Company, of El Paso, Texas, has filed an application with the Federal Power Commission proposing an $83,000,000 construction program designed to increase capacity of the company's pipe line system by 400,000,000 cu ft of natural gas a day.

El Paso proposes to deliver 150,000,000 cu ft of the additional gas jointly to Southern California Gas Company and Southern Counties Gas Company of California; 150,000,000 cu ft to Pacific Gas and Electric Company, and 100,000,000 cu ft to other customers on the El Paso system in Arizona, New Mexico, and Texas.

The proposed project includes construction of a total of 93 miles of 26 and 30-in. loop on sections of El Paso's transmission line extending from the Permian Basin in southeastern New Mexico and western Texas to the Arizona-California state line; 180,850 hp in new and existing main line compressor stations; approximately 311 miles of line in El Paso's field transmission system; 42,370 hp in new and existing field compressor stations; purification and dehydration facilities; field gathering facilities, and seven amine recovery plants.

El Paso plans to complete the facilities for Arizona, New Mexico, and Texas by October 1, 1951, and to complete the facilities for California by November 1, 1952. El Paso is presently authorized to supply the Southern California and Southern Counties companies with a total of 405,000,000 cu ft daily, and Pacific Gas and Electric with 400,000,000 cu ft a day.

Lynchburg Gas Company Wants Transco Gas

Lynchburg Gas Company, of Lynchburg, Virginia, has filed a petition with the Federal Power Commission seeking a supply of natural gas from Transcontinental Gas Pipe Line Corporation, of Houston, Texas, and a subsidiary, Lynchburg Pipe Line Company, has asked the FPC for authority to build a 15-mile line connecting the Transcontinental system with the Lynchburg Gas Company's distributing facilities.

Tanker and Storage Facilities at Savannah

The Southland Oil Corporation of Savannah, Georgia, has signed a long-term lease for a 15-acre industrial site on the Savannah property of the Georgia Ports Authority, James D. Robinson, Jr., Authority chairman, announced recently.

The 15-acre site is the first tract to be leased on the 200-acre industrial property owned by the Authority and located adjacent to its warehouses and docking facilities. The lease is a 20-year contract with option to renew.

The oil firm will develop the site for the storage of petroleum products, constructing its own pier, wharf and docking facilities for tankers on the leased river frontage. In addition, nine storage tanks with a capacity of 460,000 bbl will be installed. The tanks will be used by the government for fuel storage in connection with national defense, constituting the first defense project for the Savannah area in the current emergency, company officials reported.

Installation of these facilities is expected to be completed by June 30, 1951, Robinson said.

Within a year, other tanks having an additional 360,000-bbl capacity will be added, Norman A. McGee, president of the Southland Oil Corporation, said.

FPC Affirms Examiner's Piedmont Natural Decision

The Federal Power Commission has affirmed, with certain modifications, the initial decision of a Presiding Examiner authorizing Piedmont Natural Gas Company, Inc., of Spartanburg, South Carolina, to serve natural gas markets in North and South Carolina by constructing a series of lateral pipe lines extending from the system of Transcontinental Gas Pipe Line Corporation, of Houston, Texas.

Applications of two other companies that sought to render area wide service in the Carolinas were denied insofar as they relate to serving the markets Piedmont Natural was authorized to supply. However, the proceedings involving these two companies—Carolina Natural Gas Corporation, of Charlotte, North Carolina, and Public Service Company of North Carolina, Inc., of Gastonia, North Carolina—were ordered reopened to afford those companies an opportunity to file amendments.

The commission scheduled a hearing to begin February 20 in Washington, D. C., on these proceedings.

Examiner Edward B. Marsh's decision, as adopted by the commission, also authorizes Transcontinental to increase the sales capacity of its Texas-to-New York City pipe line by 50,000,000 cu ft a day, of which up to 22,000,000 cu ft will be delivered to Piedmont Natural.

The Piedmont Natural project includes six lateral lines, aggregating 73.7 miles. Estimated cost of the project is $1,200,000.

Transcontinental's expansion program includes an aggregate increase in compressor station capacity of 4800 hp in the first year and 40,875 hp in the second year of operation, thus increasing the sales capacity of the system to 555,000,000 cu ft a day.

Temporary OK Given For Gas Storage Test

The Federal Power Commission has granted temporary authorization for Mississippi River Fuel Corporation, of St. Louis, Missouri, to construct facilities necessary to test the gas storage possibilities of the Waterloo oil field, Illinois.

The temporary certificate authorizes the company to drill and operate not more than seven gas wells and to construct four miles of 12-in. transmission pipe line. The facilities are part of a larger project proposed by Mississippi to develop the Waterloo field as an underground storage reservoir for natural gas.

The Waterloo field is in Monroe County, Illinois.

FPC Approves Merger

The Federal Power Commission has approved Natural Gas Pipeline Company of America's proposed acquisition of all the facilities of its affiliate, Texoma Natural Gas Company. Both companies, which have main offices in Chicago, Illinois, are affiliates of The Peoples Gas Light and Coke Company, also of Chicago.

Natural and Texoma operate, under common management, an integrated natural gas transmission system and transport gas from Texas to various points in Illinois, Iowa, Nebraska, and Kansas.

Texoma's principal transmission facilities that will be acquired by Natural under the merger plan include two compressor stations, one in Hutchinson County, Texas, and the other in Moore County, Texas; a 74-mile, 24-in. pipeline from the Hutchinson County station to the inlet of Natural's system near Gray, Oklahoma; a 70-mile, 26-in. line extending from the Moore County station to the Gray inlet; gas leases, rights and estates in approximately 132,000 acres of land and 231 gas wells in the Texas Panhandle gas field, a metering station near Gray, and a natural gas system, including booster stations.

Tennessee Proposes Spending $51,028,000

Tennessee Gas Transmission Company, Houston, Texas, has asked the Federal Power Commission to authorize the construction of facilities necessary to increase the design delivery capacity of the company's pipe line system by 40,000,000 cu ft a day and the development of a gas storage project that would add 200,000,000 cu ft a day of delivery capacity to Tennessee's system during periods of maximum customer demand.

The facilities would be used to make available on peak days an additional 194,000,000 cu ft of natural gas to Northeastern Gas Transmission Company, a subsidiary of Tennessee, and to provide 46,000,000 cu ft of gas a day to be used initially to build up Tennessee's storage position and subsequently to be made available for sale. Northeastern has been authorized to serve part of the New England area with natural gas and recently filed an application for authority to serve additional customers in that area.

Tennessee's proposed new construction program is estimated to cost $51,028,000. The project would include approximately 438 miles of loop on Tennessee's Buffalo and New England extensions; compressor units aggregating about 44,000 hp in existing or authorized stations, and approximately 14,000 hp in a new compressor station. The company said that the exact location of the storage field and pertinent geologic representations will be supplied in advance of the hearing on the application.

Loop Line Asked By Tennessee Gas

Tennessee Gas Transmission Company, Houston, Texas, has filed an application with the Federal Power Commission seeking authorization to construct 25 miles of 26-in. loop line along its authorized Buffalo extension and to install 2000 additional hp at an existing compressor station.

The proposed new facilities would be used to transport 25,000,000 cu ft of natural gas a day to Tennessee's northern rate zone for delivery to The Manufacturers Light and Heat Company, of Pittsburgh, Pennsylvania. The sale of this gas previously was authorized by the FPC and it is currently being delivered to United Fuel Gas Company, of Charleston, West Virginia, in Tennessee's eastern rate zone for the account of The Manufacturers Light and Heat Company. United and Manufacturers are affiliates in the Columbia Gas System.

Estimated cost of the new facilities is approximately $2,454,000.

PROJECTS

Transcontinental Authorized New Compressor Capacity

The Federal Power Commission has granted temporary authorization to Transcontinental Gas Pipe Line Corporation, of Houston, Texas, to install a total of 45,675 hp in compressor capacity at existing stations on its Texas-to-New York City natural gas pipe line.

The Commission reserved decision with respect to deliveries and sales of the 50 million cu ft of gas per day to be made available by the construction. The project will increase the capacity of Transcontinental's system to 555 million cu ft daily.

A Commission Presiding Examiner last month filed an initial decision which would, among other things, authorize these Transcontinental facilities and the construction by Piedmont Natural Gas Company, Inc., of facilities to serve natural gas markets in North and South Carolina. Under that authorization, Transcontinental would supply Piedmont with up to 22 million cu ft of gas per day. The Examiner's decision is now under review by the Commission.

In addition to the compressor facilities authorized in the temporary certificate, Transcontinental is proposing to install 41 sales meter stations. Estimated capital cost of the entire project is $7,946,025.

More Gas Sought For Northeast Ohio

The East Ohio Gas Company, Cleveland, Ohio, has asked the Federal Power Commission to authorize construction of a 65-mile, 26-in. pipe line, which would carry an additional supply of natural gas into the company's system to meet increasing demands in northeastern Ohio.

The proposed line, estimated to cost $4,382,170, would connect with the system of New York State Natural Gas Corporation at a point on the Ohio-Pennsylvania state line, near Petersburg, Ohio, and extend northwest to a point in Twinsburg Township, in Summit County, Ohio. New York State Natural, an affiliate of East Ohio in the Consolidated Natural Gas Company System, would deliver gas to East Ohio.

East Ohio said that New York State Natural is planning a companion project and will file an application with the FPC for authority to develop additional storage facilities in western Pennsylvania and to install a pipe line extending to the connection with East Ohio's proposed line.

Texas Gas Would Lay 564 Miles Pipe Line

Texas Gas Transmission Corporation, of Owensboro, Kentucky, has asked the Federal Power Commission for authority to build approximately 564 miles of main and loop pipe lines in Louisiana, Arkansas, Mississippi, Tennessee, and Kentucky. Estimated construction cost is $42,310,000.

The applicant says the proposed new facilities would be used to help meet the increasing natural gas demands of its customers and to supply an additional 20,000,000 cu ft a day to Louisville Gas and Electric Company and an additional 95,000,000 cu ft per day to The Ohio Fuel Gas Company.

The proposed facilities include a 195-mile line in Louisiana from Acadia Parish to a connection with the company's existing facilities in Morehouse Parish. This line would consist of 160 miles of 26-in. pipe and 35 miles of 24-in. pipe. In addition, Texas Gas would build about 369 miles of 26-in. loop line on sections of its existing system between Morehouse Parish, Louisiana, and the Hardinsburg, Kentucky, area.

The proposed project also includes a new 4400-hp compressor station near Madison, Indiana; installation of a total of 9340 additional hp at four existing compressor stations; underwater crossings of the Mississippi and Ohio Rivers; sales lateral facilities, and a sales meter station.

Gas Supply Ordered to Mississippi Cities

The Federal Power Commission has ordered Tennessee Gas Transmission Company, Houston, Texas, to connect its pipe line system with facilities to be built by the City of Ripley, for the delivery and sale of natural gas to the cities of Ripley, Booneville, and Baldwyn, Mississippi.

The FPC order directs Tennessee to sell up to 1,000,000 cu ft of gas a day to Ripley, up to 700,000 cu ft a day to Booneville, and up to 350,000 cu ft a day to Baldwyn, or a total volume of not to exceed 2,050,000 cu ft.

The connection with Tennessee's system will be made in Benton County, Mississippi. Facilities to be built by the three cities include 16 miles of 6-in. line extending from Tennessee's system to Ripley, with a connection at that point to serve Ripley and Blue Mountain. The 6-in. line will then extend 22 miles toward Booneville and Baldwyn with a 5-mile tap line to Baldwyn and Wheeler and a 6-mile tap line to Booneville. The overall system will have a capacity to handle up to 8,640,000 cu ft a day.

Texas Gas Proposes New Compressor Station

Texas Gas Transmission Corporation, of Owensboro, Kentucky, has asked the Federal Power Commission to authorize the construction of a compressor station with 3960 installed hp on the company's main 20-in. natural gas line near Shreveport, Louisiana.

The proposed compressor station would increase the daily capacity of the company's 20-in. line, which extends from the Carthage gas field in East Texas to a connection with Texas Gas Transmission's main system near Sharon, Louisiana, from 190,000,000 cu ft to about 238,000,000 cu ft. Estimated cost of the compressor station is approximately $1,046,000.

The application says that the installation and operation of the proposed station is primarily to meet the peak requirements of the company's existing customers and to permit Texas Gas to purchase additional gas in the Carthage field. The company does not anticipate any material increase in its annual firm sales to existing customers as a result of the new station.

FPC Permit Involves New Line Construction

The Federal Power Commission has granted proposals of New York State Natural Gas Corporation, of New York City, and Niagara Mohawk Power Corporation, of Syracuse, New York, involving natural gas service to Watertown and other communities in northeastern New York State.

New York State Natural was authorized to make additional sales of gas to Niagara Mohawk, which in turn received authorization to build a 55-mile, 10¾-in. pipe line from Fulton, New York, to Watertown. Estimated cost of Niagara Mohawk's project is $1,991,000.

The authorization will enable Niagara Mohawk to convert its present manufactured gas territory in Watertown to straight natural gas service. In addition, Niagara Mohawk will provide straight natural gas along the route of the new line in the towns of Mexico, Pulaski, Mannsville, Adams, Adams Center, Sandy Creek, Lacona.

The FPC conditioned both authorizations to require the two companies to file a service agreement requiring New York State Natural to supply Niagara Mohawk with all of the natural gas required by the present and future domestic and commercial consumers served by Syracuse Suburban Gas Company, Inc., within its distribution territory in Onondaga County, New York, and all normal expansion within this territory.

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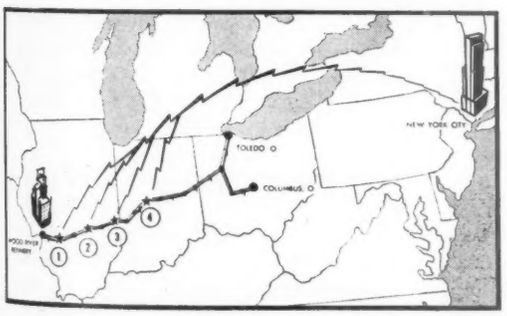

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With the PIPE LINE CONTRACTORS

Vaughn and Taylor Construction Company, Inc., P.O. Box 1351, Wichita Falls, Texas, is engaged in laying a 133-mile low pressure gathering system in Snyder County, Texas, to serve Sunray Oil Corporation's gasoline plant. The system is being constructed of pipe varying in size from 3 to 30 in.

In the Sherman field, Texas, a gas gathering system is being laid for Phillips Petroleum Company. This consists of 99 miles of 3 through 16 in. pipe.

O. R. Burden Construction Company, P.O. Box 5216, Tulsa, Oklahoma, was one of the successful bidders for construction of the Platte Pipe Line Company system. This contractor was awarded approximately 295 miles of the line, its section extending from a point near St. Joseph, Missouri, to the terminus of the system in the St. Louis-Wood River area. The line overall will consist of 1072 miles of 16-in. and 20-in. pipe and will have its origin in Wyoming. It will be a crude oil carrier.

Burden now has under construction 56.5 miles of 10¾-in. for The Texas Pipe Line Company between Lawrenceville, Illinois, and Mount Vernon, Indiana, which will parallel Texas' existing 6-in. line. The field office is at Mount Carmel, Illinois. Pete Hiner is spread superintendent.

Rumsey Brothers Pipe Line Construction Company, M. and M. Building, Houston, Texas, has been awarded a construction contract for approximately 100 miles of the Platte Pipe Line Company's system. The section will begin at the Nebraska-Kansas state line near Lanham, Kansas, and extend to the Missouri River near Doniphan, Kansas. Joe Al Works is superintendent and Walter A. Hale manager of the field office. Platte's overall system will extend from Wyoming to the St. Louis-Wood River area. The pipe will be of 16-in. and 20-in. in diam.

Delmer M. Spafford, 823 West Main Street, Farmington, New Mexico, is laying an undetermined amount of gathering lines in the Blanco field for Southern Union Gas Company. The pipe is 4, 6, 8, 10, and 12 in. diam. Delmer Spafford is in charge of the work; J. C. Smithee, ditch; Roy Scribner, dope, and Bob Hall, welding.

About February 5 work will begin on 10 miles of 12-in. for Southern Union on its Albuquerque main line. Delmer Spafford is general superintendent. C. Peters is superintendent and the following are foremen: C. Mahan, ditch; L. Coy, pipe; J. Tafoya, dope, and C. Hicks, welders.

After completion of the above, 5½ miles of 12-in. will be laid on the Kutz Canyon end of the Albuquerque main line for Southern Union.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, is devoting its entire attention at the moment to work on the Texas Illinois Natural Gas Pipeline Company system. The jobs are as follows:

Schedule 1 — Approximately 100 miles of 26-in. from LaGloria to Refugio, Texas. Field office: Refugio, Texas. Superintendent: M. T. Wilhite. Spreadman: Denver Franklin. The job was 75 per cent completed January 12.

Schedule 11—Approximately 100 miles of 30-in. from the Mississippi River near Chester, Illinois to Effingham, Illinois. The field office is at DuQuoin. M. T. Wilhite is superintendent and John Work spreadman. The job has been shut down for the winter with the work 28 per cent done.

Schedule 12—Approximately 100 miles of 30-in. from Effingham to Sibley, Illinois. Work scheduled for 1951.

Schedule 13 — Approximately 92 miles of 30-in. from Sibley to Joliet, Illinois. Scheduled for 1951.

The crossing of the Illinois River near Morris, Illinois, is approximately 60 per cent completed. The field office is at Morris. Clyde Peters is superintendent; Bill Daniels office manager.

H. L. Gentry Construction Company, 921 Michigan Avenue, Jackson, Michigan, had completed 6 miles to January 20 of the 55 miles of 12¾-in. pipe being laid for the Southeastern Michigan Gas Company between Birmingham and Port Huron, Michigan. The coating material is a new non-acid type, the wrapper a plastic material. The field office is at Utica; the telephone 75122. Frank Morris is superintendent and Joe Malloy office manager.

Work began January 15 on 11,000 ft of 20-in. for Ohio Fuel Gas Company, this being city work in Toledo. James Mitchell is superintendent and Herman Stowers office manager.

City work also is being done in Cincinnati and Norwood for the Cincinnati Gas and Electric Company, consisting of 23,600 ft of 20-in. Milo Larsen is superintendent.

R. H. Fulton and Company, P.O. Box 1526, Lubbock, Texas, has been awarded the contract for about half of Platte Pipe Line Company's 1072-mile system. The Fulton section extends from Chatham station in Wyoming to Brule, Nebraska. This crude oil carrier, which will be constructed of 16-in. and 20-in. pipe, has its headquarters in Independence, Kansas.

A contract was recently obtained for the laying of 56 miles of 12¾-in. pipe between Wichita Falls, Texas, and Chico station in Wise County for The Texas Pipe Line Company. This work is being handled out of a field office at Henrietta, Texas, with M. L. Boyd spread superintendent and C. E. Helwig in charge of the office.

Work on the 184 miles of 26-in. for Trunkline Gas Supply Company between Senatobia, Mississippi, and Joppa, Illinois, has been shut down because of bad weather. The field office for this job is at Memphis, Tennessee. Ed Veach is spread superintendent and Bill Gray office manager. Clark Williams is general superintendent.

The contractor also is laying 155 miles of 20-in. between Jetmore and Bushton, Kansas, and 73 miles of 26-in. from Concordia to Salina, Kansas, for the Northern Natural Gas Company. Jerry Nash is in charge of the former job and M. L. Boyd of the latter.

R. H. Fulton and J. T. Brodie, as a joint venture, are laying 264 miles of 20-in. between McAllen and Altair, Texas, for Trunkline Gas Supply Company. J. T. Brodie is in charge. Bill Fenn is spread man. The field office is at Victoria.

Bishop and Lock, 503 Magnolia Building, Dallas, Texas, has been awarded a contract to lay that part of Platte Pipe Line Company's system between Marysville, Kansas, and Holdrege, Nebraska, a distance of 142 miles. Due to delay in pipe delivery, the work is not expected to get under way until sometime in May. This is part of Platte's crude oil line from Wyoming to the St. Louis-Wood River area.

Tulsa Construction Company, Inc., 114 East Fifth Street, Tulsa, Oklahoma, is now engaged in laying 40 miles of 12-in. for the Mid-South Gas Company from Helena to Forest City, Arkansas. Frank McCoy is superintendent and Bill Robinson manager of the field office.

Bechtel Corporation, 220 Bush Street, San Francisco, California, is operating three spreads on the 409 miles of 30-in. it is laying for Texas Illinois Natural Gas Pipeline Company in Arkansas and Missouri. At Newport, Arkansas, J. E. Richardson is spread superintendent; at Texarkana, Arkansas, V. L. Williams is superintendent, and at Poplar Bluffs, Missouri, A. M. Berlander. The project office is at 409 East Markham Street, Little Rock, Arkansas. E. W. Davis is division manager, E. J. Hayes division office manager, and E. C. Elting project office manager.

Bechtel recently completed 54 miles of 20-in. for Ohio Oil Company in Illinois.

H. C. Price Company, Somastic Division, Bartlesville, Oklahoma, has the following work in progress:

Philadelphia plant operations:

Okonite-Callender Cable Company, Inc.—Application of Somastic coating and internal cleaning and coating to 31,150 ft of 6⅝ in. OD pipe; 25,720 ft of 5 9/16-in. OD pipe; 1850 ft of 6⅜-in. OD pipe.

Sun Oil Company—Application of coating to 2100 ft of 8⅝-in. OD pipe.

Phelps-Dodge Corporation—Application of coating and internal cleaning and coating to 55,500 ft of 5 9/16-in. OD pipe.

Susquehanna Pipe Line Company—Application of coating to 5000 ft of 6⅝-in. OD pipe.

Philadelphia Electric Company—Application of coating to 64,750 ft of 16-in. OD pipe; 1000 ft of 20-in. OD pipe.

New Orleans plant operations:

United Gas Pipe Line Company—Application of Somastic coating to approximately 66,000 ft of 6⅝-in. OD pipe; 42,000 ft of 8⅝-in. OD pipe; 35,500 ft of 10¾-in. OD, 0.307-in. wall pipe; 52,800 ft of 12¾-in. OD pipe; 47,500 ft of 16-in. OD ¼-in. wall pipe; 322,000 ft of 16-in. OD, 5/16-in. wall pipe; 14,500 ft of 16-in. OD, ½-in. wall pipe.

H. C. Price Company, Pipeline Division, P.O. Box 1111, Bartlesville, Oklahoma, has the general contract covering construction of approximately 480 miles of main transmission line for Texas Illinois Natural Gas Pipeline Company from near Refugio, Texas, northeast to the Texas-Arkansas state line near Texarkana. Work on 36 miles of 24-in. extension to Old Ocean field near Hungerford has been completed. Work on 110 miles of the main 30-in. line from Hungerford to the Trinity River has been completed, as has 38 miles of 12-in. from Old Ocean field to Chocolate Bayou field and 97 miles of 26-in. from Hungerford to near Refugio. Work on 200 miles of 30-in. from Trinity River to Texarkana will begin in spring. Overhaul of equipment now in progress. Spreads are located as follows:

Wharton, Texas: W. B. Williams, superintendent; P. O. Rutledge, office manager; and these foremen: R. H. Edwards and D. L. Beachy, right-of-way; K. K. Kelly, ditch; Roy Stegall, bending; J. I. Cobb, pipe; C. F. Jones, welding; Rube Owens, coating; A. D. Hamilton, lower-in; Fred Williams, clean-up.

Tomball, Texas: C. R. Ice, superintendent; G. A. Harvey, office manager; and these foremen: John E. Hamilton and Jessie Cash, right-of-way; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in; E. D. Worley, clean-up.

Associated Pipe Line Contractors, Inc., P.O. Box 2163, Houston, Texas, is constructing 121 miles of 16-in. pipe line for Southern Natural Gas Company from Tuskegee, Alabama, to Macon, Georgia. The field office is at Columbus, Georgia. Lacy Walker is superintendent and "Buck" Johnson office manager.

Trojan Construction Company, Inc., P.O. Box 4427, Oklahoma City, Oklahoma, began work January 26 on 53 miles of 26-in. for the Oklahoma Natural Gas Company. The section extends from Edmond to Depew, Oklahoma. The field office is at Stroud.

Dunn Bros., 801 Mercantile Securities Building, Dallas, Texas, are engaged in stringing 471 miles of pipe for H. C. Price Company on the Texas Illinois Natural Gas Pipeline Company project, as follows:

Section 2—100 miles of 26-in. from Refugio to Glenflora, Texas.

Section 3—36 miles of 24-in. from Old Ocean, Texas, to the main line, and 36 miles of 12-in. from Chocolate Bayou to the main line.

Section 4—109 miles of 30-in. from Glenflora to Urbana, Texas.

Section 5—91 miles of 30-in. from Urbana to Dotson, Texas.

Section 6—99 miles of 30-in. from Dotson to the Texas-Arkansas state line.

Other jobs being strung by the company are as follows:

El Paso Natural Gas Company—415 miles of 24-in. between Fruitland, New Mexico, and Yucca, Arizona. (San Juan line.)

El Paso Natural Gas Company—419 miles of 30-in. in New Mexico, Texas, and Arizona.

Conyes Construction Company, 2884 San Pablo Avenue, San Pablo, California, is laying 100 miles of 22-in. crude oil line for Ohio Oil Company from Carloa, Indiana, to the Illinois state line. Jimmy Allman is superintendent in charge of construction.

Western Pipeline Constructors, Inc., Austin, Texas, are laying 97 miles of 26-in. and 38 miles of 12-in. on the Texas Illinois Natural Gas Pipeline Company system.

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▸ **Parkhill Truck Company,** P.O. Box 1856, Tulsa, Oklahoma, is stringing 217 miles of 24-in. for Anderson Brothers Construction Company on Trunkline Gas Supply Company job from Longville, Louisiana to Garwood, Texas.

Other jobs are: For Houston Contracting Company, 176 miles of 26-in. on Trunkline between Longville and Darnell, Louisiana. Foremen are F. L. Bridges and O. C. McCoy.

For Midwestern Constructors Inc., on Texas Illinois Natural Gas Pipeline 100 miles of 26-in. from La Gloria to Refugio, Texas. Harold Deatherage is foreman.

Sections 7, 8, 9, and 10 on the Texas Illinois for Bechtel Corporation, 417 miles of 30-in. from Texarkana, Arkansas, to the Mississippi River near Cape Girardeau, Missouri. Foremen: Charles Sampson on Section 9; Jimmie Stubblefield 7.

Sections 11, 12, and 13 on the Texas Illinois job, for Midwestern Constructors, Inc., 300 miles of 30-in. from the Mississippi River near Cape Girardeau to Joliet, Illinois. Curtis Williams is foreman.

For Anderson Brothers on Trunkline system, 180 miles of 26-in. from Darnell, Louisiana to Senatobia, Mississippi. The foreman is Ira Gould.

For Bechtel Corporation, 54 miles of 20-in. from Wood River to Patoka, Illinois. Ray Herron is foreman.

▸ **Texas-Louisiana Construction Company,** 804 Dan Waggoner Building, Fort Worth, Texas, completed the latter part of January 50 miles of 30-in. for United Gas Pipe Line Company. The pipe was laid from a point near Wharton, Texas, to Missouri City. "Borger Red" McMenamy was in charge of one spread and Jimmy Reid another.

▸ **Anderson Brothers Construction Company,** 707 Drennan Street, Houston, Texas, has been doing what work it could between Garwood and the Sabine River in Texas for Trunkline Gas Supply Company. Delay in pipe delivery, however, has held up work considerably. This is a 174-mile section and the field office for construction crews is at Liberty.

Other sections also are under contract for Trunkline. One consists of 127 miles of 26-in. between Greenville and Senatobia, Mississippi. Bad weather has delayed progress here. A 42-mile section between Longville, Louisiana, and the Sabine River is under the supervision of Dick Jernigan.

Jobs with two different companies have been closed down awaiting spring weather, which will permit their completion. One is 40 miles of 30-in. for Tennessee Gas Transmission Company from Campbellsville to Lebanon, Kentucky; the other is 57 miles of 8-in. between Cincinnati and Dayton, Ohio, for the Miami Valley Corporation.

▸ **J. L. Cox and Son,** Raytown, Missouri (stringers), is taking up and hauling 188 miles of 6 and 8-in. pipe between Chico, Fort Worth, and Ranger, Texas. This is on The Texas Pipe Line Company system. The take-up was about 50 per cent completed on January 22. J. R. Lyerla is foreman.

Stringing began February 1 of 56.6 miles of 10-in. for The Texas Pipe Line Company between Lawrenceville, Illinois, and Mount Vernon, Indiana. Fred Osterman is in charge.

▸ **Mahoney Contracting Company,** 1234 South Holmes Street, Lansing, Michigan, is getting well along with its job for Trunkline Gas Supply Company. This contractor is laying 186 miles of 26-in. between Tuscola and Joppa, Illinois. Recently completed was 30 miles of 12-in. for Dow Chemical Company between Loomis and Midland, Michigan.

▸ **Williams Brothers Corporation,** National Bank of Tulsa Building, Tulsa, Oklahoma, has contracted to lay 707 miles of line for Plantation Pipe Line Company, paralleling its system between Baton Rouge, Louisiana, and Charlotte, North Carolina. From Baton Rouge to Bremen, Georgia, a distance of 432 miles, the pipe will be of 18 in. diam. From Bremen to Charlotte, 275 miles, it will be 14 in. The main field office is at Tuscaloosa, Alabama, with George Allen the general superintendent. Crossings also are being made of the Black Warrior and Tombigbee rivers. A crossing already has been made of the Pearl River.

In December this contractor began laying 26 miles of 16-in. for Citizens Gas and Coke Utility from Indianapolis, Indiana, to make a connection with Panhandle Eastern Pipe Line Company's system.

▸ **Arabian Bechtel Corporation,** 220 Bush Street, San Francisco, California, is laying 566 miles of pipe for Iraq Petroleum Company from the Kirkuk field in northern Iraq to Banias on the Mediterranean seaboard. Clark Rankin, Bechtel vice president, is project manager.

NACE Expects Its Largest Meeting in New York

Dr. Norman Hackerman, chairman of the technical program committee for the 1951 general conference and exhibition to be held by the National Association of Corrosion Engineers at the Hotel Statler, New York City, on March 13-16, has released the details of the program to be presented, which includes many papers of interest to members of the petroleum industry.

Many members of NACE will make use of advance registration, but for those who do not, registration will begin in advance of the regular sessions, on Monday, March 12, and will be followed by meetings of the technical practices committees of the association.

The 1951 exhibit held in conjunction with the annual conference will be the largest ever held by NACE, according to G. E. Seidel, chairman of the exhibition committee. Exhibitors will set up displays on Monday, March 12, and will sponsor a fellowship hour for all delegates and guests on Tuesday evening.

In addition to the excellent technical program to be presented covering many varied phases of corrosion problems, techniques, and materials and services, and also in addition to the record number of exhibitors who will be available for consultation, a broad program of entertainment has been arranged for the diversion of the delegates and their guests. The entertainment committee headed by Linden Stuart, Jr., has worked in cooperation with exhibitors to arrange for the fellowship hour, and has planned for the annual banquet to be held on Thursday, March 15, at the Hotel Statler for a fast-moving program of noted talent. Provisions are also being made for obtaining tickets for theater and sporting events in cooperation with the New York convention and visitors bureau. Mrs. Beatrice Bailey has initiated activities for her ladies committee including an introductory tea on Monday, broadcast visits and tea at the Rainbow Room on Tuesday, lunch and fashion show in the Hotel Pierre's Cotillion Room on Wednesday, United Nations meeting, and tea on a trans-Atlantic liner on Thursday, March 15.

Advance reports received from local representatives of the conference committee in all sections of the country indicate that the NACE 1951 conference and exhibition will be the biggest, most interesting and educational and most exciting ever held.

NEWS

Oil Consumption Hits All-Time High in 1950

The American Petroleum Institute has reported domestic demand for 1950 set a new record for the eighth consecutive year and exceeded 2 billion bbl for the third consecutive year. This represented an 11 per cent increase from 1949. Total demand was estimated at 2461 billion barrels or 6,743,000 bbl daily. This surpassed the previous high of 2248 billion barrels or 6,143,000 bbl daily set in 1948 and was about 10 per cent above the 1949 level of 2233 billion barrels.

The API reported that motor fuel output passed the billion mark for the first time, reaching 1105 billion barrels, up 6 per cent from 1949. Demand also set a record. Fuel oil demand for gas oil and distillate reached a new peak, up 19 per cent from 1949.

Well completions set a new record with 43,000 up 3400 from 1948. Refinery capacity hit a new high with 6,723,000 bbl daily, up 114,500 bbl from 1949. Runs to stills were estimated at a record 2,091,285,000 bbl, compared to a previous high of 2,048,349,000 bbl in 1948.

Natural gas sales were up 20 per cent from 1949. Production neared 9 trillion cubic feet, compared with 7.5 trillion in 1949. Domestic crude oil output was estimated at 1,973,000,000 bbl, up 133,000,000 from 1949.

Aramco and Saudi Arabia Agree on Split of Profits

The Arabian American Oil Company and Saudi Arabia have signed an agreement calling for a 50-50 split in profits from the oil the American company takes out of that Middle East country. The new agreement, which is retroactive to January 1, 1950, provides that Aramco will pay up to and not exceeding 50 per cent of its net profits in income taxes to Saudi Arabia, after income taxes to the United States have been deducted. In addition, Aramco will continue to pay the present 34-cent royalty per barrel. Over-all payments to Saudi Arabia will amount to about 50 cents per barrel.

Desert Oil Field Concession

Independent Oil Company of Kuwait has obtained a 99-year concession on a new desert oil field in the border area of Saudi Arabia and the Emirate of Kuwait. According to reports this may be one of the richest oil fields in the world. The oil is near the surface and the field is only 8 miles from the Persian Gulf.

Sulfur Production on Commercial Scale Is Indicated At Canadian Gulf's Pincher Creek Gas Field, Canada

The prospect of sulfur production on a commercial scale for the first time in Canada was indicated in a lengthy report by Canadian Gulf Oil Company on its Pincher Creek wet gas field in southwestern Alberta. Rated the largest individual natural gas reserve in Canada, this field is stated by Gulf engineers to be capable of producing about 1035 billion cubic feet to a minimum bottomhole pressure of 1000 psi from average initial bhp of 4868 psi. In addition to the gas, Pincher Creek may produce 24.6 million barrels of condensate and about 3,500,000 tons of sulfur. This rate of production might be spread over a field life of 43 years.

The ultimate recovery, with use of secondary recovery methods, is estimated at 1500 billion cubic feet of gas, 35,000,000 bbl of condensate and 5,250,000 tons of sulfur. Gulf states it will build a sulfur extraction plant at a cost of about $3,000,000 if export of gas is allowed, making the field development economic. Daily gas production of 100,000,000 cu ft would permit extraction of 250 tons of sulfur from the 9 per cent H_2S content.

Gulf has just announced an expensive research program on corrosion problems, restriction of formation of hydrates, and various types of condensate recovery separating devices to determine best operating practices. The Madison limestone reservoir has an average producing depth of about 12,000 ft, hence the desire to have all preliminary research completed before any immediate necessity or opportunity arises for development and production at a cost of about one million dollars per well. With favorable market development, Gulf is prepared to put another rig or two on its property to complete a maximum of 20 wells. At present the company is using a contract National 125 with rated capacity of 14,000 ft, which is presently on the fourth well. Two large gas producers, rated the biggest in Canada, and one dry hole, have been completed.—L.O.R.

New Members Inducted. A part of the December meeting of the Houston, Texas Nomads was devoted to the induction of new members by C. F. (Bud) Vincent of Byron Jackson Company. Receiving their certificates and pins from E. L. Lorehn, Houston Nomads president, are William A. Griffin, Jr., Daniel Orifice Fitting; J. D. Rice, W-K-M Company, and Charles Gearke, Baash-Ross Tool Company. Vincent is deputy sergeant at arms.

Continental Oil Sets Up College Scholarship Plan

Details of Continental Oil Company's college scholarship plan have been completed and the first awards—10 each year to sons and daughters of Continental employees—will be made for the fall term of 1951, it was announced by L. F. McCollum, president. The plan, conceived last year in observance of Continental's 75th anniversary, provides that scholarships of $500 each will be awarded each year on a competitive basis to 10 applicants chosen by committee.

Shell Sets Up Sumatra Oil School

A petroleum school to train Indonesians to hold responsible positions in the oil industry has been set up at Prabumulih in South Sumatra. A total of 24 students will be taken from various parts of the Indonesian archipelago, the number to be increased to 50 in the near future. Financial support for the school will be provided by N. V. De Bataafsche Petroleum Mij. (Royal Dutch Shell), which will open a similar school at Pladju near the company's Sumatra fields.

Dallas Firm to Control American Oil Consolidated

Directors of North American Oil Consolidated, San Francisco, California have voted approval of transfer of control to General American Oil Company, Dallas, Texas in a transaction involving approximately $25,000,000. Tevis F. Morrow, former Dallas oil man, recently obtained control of North American Oil Consolidated in a purchase at $80 per share of a majority of the firm's 271,659 outstanding shares. Most of North American Oil's properties are in California with other properties scattered in New Mexico, Texas, Oklahoma, Louisiana, Arkansas.

NPC Names Materials Group

A committee to study the needs of the oil and gas industries for materials and chemicals has been formed by the National Petroleum Council. Reese H. Taylor, president of Union Oil Company of California has been named to head the committee, which was formed at the request of Hugh Stewart, director of the Interior Department's Oil and Gas Division. Stewart said that in addition to steel, there are numerous other materials and chemicals such as copper, aluminum, zinc, cobalt, nickel, and sulfur already in short supply.

Other members of the committee are A. W. Thompson, Houston, Texas; Jake L. Hamon, and D. A. Hulcy, Dallas, Texas; W. K. Warren, Tulsa, Oklahoma; Munger T. Ball, Port Arthur, Texas; Paul G. Blazer, Ashland, Kentucky; B. C. Graves, Robert E. Wilson, and B. L. Majewski, Chicago; and S. F. Niness, Downingtown, Pennsylvania; B. I. Graves, W. G. Maguire, Stuart M. Crocker, and John R. Suman, New York City, and T. Sutter, Los Angeles, California.

Cities Service Opens New Montana Office

Cities Service Oil Company (Delaware) is opening an office at Billings, Montana, to house its district land and exploration staff. Temporary quarters have been obtained in the Peters Building and the offices will be opened as soon as furniture and supplies arrive. Permanent quarters will be in the Montana National Bank Building Annex, which is scheduled for completion about the middle of this year. Allan Cree will be the Billings district geologist, J. A. McIntosh district development geologist, Richard Model geological scout, Mac Fitts district geophysical supervisor, and C. P. Kimpel district landman.

World Crude Output Continues to Rise

World crude production during July, 1950 averaged 10,546,000 bbl daily, an increase of 116,000 bbl daily over the June production rate, the U. S. Bureau of Mines has reported. Largest daily average gains over June were: U. S. 106,000 bbl, Canada 11,000, Colombia 8000, and the U.S.S.R. 25,000 bbl estimated. Largest decrease in daily average production were: Venezuela 39,000 bbl, Iraq 9000 bbl and Egypt 7000 bbl. New monthly production records were established in Canada, Venezuela (although daily average production decreased from June), Colombia, and Kuwait. The report has added bunker oil deliveries to its statistics.

Crude oil imports of western Europe decreased 153,000 bbl daily from the high June receipts as nearly all the major crude consumers reported lower imports, the Bureau of Mines report stated. Principal importing countries were, in barrels daily: France 238,000 bbl June 315,000, United Kingdom 177,000 (198,000), Italy and Trieste 100,000, unchanged from last month, the Netherlands 96,000 (159,000), and western Germany 38,000 (49,000).

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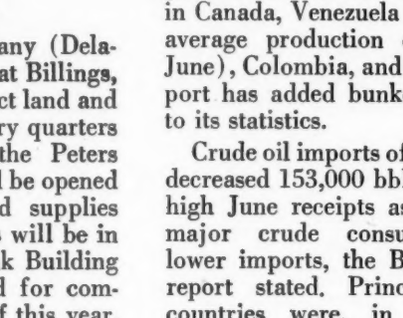

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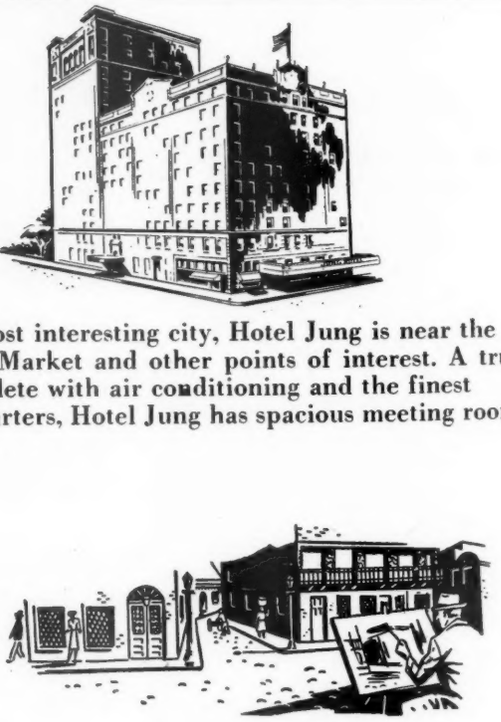

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AFFILIATED NATIONAL HOTELS

NEWS

Patrick Named President Of PEPA at Annual Meet

R. E. Patrick, Kansas Gas and Electric Company, Wichita, Kansas, was elected president of the Petroleum Electric Power Association during the association's 22nd annual meeting at Hot Springs, Arkansas recently. Other new officers named were T. E. Graham, Oklahoma Gas and Electric Company, Oklahoma City, vice president, and Ned W. Beaudreau, Central Power and Light Company, Corpus Christi, Texas, secretary-treasurer.

Six new directors selected for two-year terms include D. S. Coffman, Texas Power and Light, Dallas, Texas; R. N. Crossman, Houston Lighting and Power, Houston, Texas; Jim Moody, Southwestern Gas and Electric, Shreveport, Louisiana; Thomas E. Graham, Oklahoma Gas and Electric, Oklahoma City, and J. W. Lambert, Southwestern Public Service, Borger, Texas.

Next year's convention will be held in Houston, Texas.

O. C. Bailey, chairman, Arkansas Oil and Gas Commission, El Dorado, Arkansas, delivered the address of welcome to the approximately 100 delegates. Speakers appearing on the opening day's program were Joe Carle, sales manager for Reda Pump Company, Bartlesville, Oklahoma, who discussed the "Development and Operation of the Submergible Pump;" W. L. Pearson, power engineer for Southwestern Public Service, Lubbock, Texas, whose subject was "What Is Power Factor?"; Mitchell Tucker, advertising manager, Oil and Gas Journal, Tulsa, discussed "The Prospects and Attitudes of the Oil Industry Towards Purchased Electric Power;" C. W. Chachere, electrical engineer, Gulf Refining, Shreveport, talked on "Electric Equipment Installations, Smackover Field, Arkansas;" Peter Grandone, petroleum engineer, Bureau of Mines, Bartlesville, Oklahoma, discussed "Mechanics of Water Flooding."

During the noon hour the delegates were guests of Ted Workman Advertising, Dallas, at a luncheon.

Three papers were presented: "Industrial Revolution in the Southwest," W. M. Shepherd, vice president, Arkansas Power and Light; "Development of Utilization of Present Day Fuels," W. M. Carney, general superintendent, refinery, Lion Oil Company, El Dorado, Arkansas, and "Supervisory Controls for Pipelines," William A. Derr, Westinghouse Electric Corporation, East Pittsburgh.

O. C. Bailey congratulates R. E. Patrick, Kansas Gas and Electric, Wichita, Kansas, upon his election to the presidency of PEPA. Left is T. E. Graham, Oklahoma Gas and Electric, Oklahoma City, vice president, and Ned W. Beaudreau, Central Power and Light, Corpus Christi, Texas, secretary-treasurer.

Texas Has Record Number Of New Oil Fields in 1950

A total of 562 new oil fields and 76 additional gas areas were discovered in Texas during 1950, giving the state an all-time high discovery record. Four-hundred and seventy-eight oil and 95 gas discoveries were made in 1949.

Oil well completions set a record in 1950 also, with a total of 10,661, which compared favorably with the 8911 discovered in 1949. Gas well additions totaled 741 compared with 712 in 1949.

In 1950 4597 dry holes were drilled compared with 3935 drilled during the previous year. Wildcats totaled 3080 against 2630 projects of 1949. On December 31, 1950, there were 125,165 oil producing wells in Texas compared with 116,937 on the same date in 1949.

Texas produced a total of 852,587,076 bbl in 1950, an increase of some 118,000,000 bbl over the previous year.

Total gas production was 3913 billion cubic feet, about one-half trillion cubic feet above the 1949 all-time mark.

Honolulu Oil Reserves at 163,500,000 Bbl Mark

Honolulu Oil Corporation's reserves of crude oil and natural gasoline and other natural gas liquids were 163,500,000 bbl on October 1, 1950, according to a report of DeGolyer and MacNaughton, geologists. The company has made application for listing its shares on the New York Stock Exchange. It is now traded on West Coast exchanges. DeGolyer and MacNaughton broke down the petroleum reserves of the company as: Crude oil, 139,500,000 bbl of proved developed reserves and 8,400,000 bbl of proved undeveloped reserves, and natural gasoline and other natural gas liquids, 15,600,000 bbl of proved developed reserves.

The geologists also estimated that Honolulu had, as of October 1, net proved natural gas reserves of 285.9 billion cubic feet, of which 285 billion cubic feet were considered developed and 900,000,000 cu ft were not.

Continental Oil Depicts History From 1875-1950

Continental Oil Company, climaxing a year-long celebration of the company's 75th anniversary, has published a 48-page booklet that integrates Continental's long history with that of the United States during the same period, 1875-1950.

The booklet depends heavily upon pictures to tell its story. It uses the device of a grandfather, recently retired from Continental, who recounts the company's history and that of the nation through a photographic album being shown to his grandson.

Through the interspersion of company history, the development of the U. S., and pictures typical of the various stages Continental and the nation have come through since 1875, the booklet gives a panoramic view of the entire past three-quarters of a century.

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Havenstrite Sells Plant, Producing Properties

Sale of the Havenstrite Oil Company's natural gasoline plant at Castaic to Union Oil Company of California and of Havenstrite's producing properties at Del Valle oil field to Nassau Associates, Inc., a subsidiary of Dillon Read and Company, for a total of $12,000,000 has been announced. Union Oil will enter into a crude oil purchase contract with Nassau Associates to purchase the 2000-bbl per day crude oil production of the Havenstrite properties. This deal does not include any of the other oil producing properties of Havenstrite Oil at Long Beach, in Kern County, South Mountain Oil field in Ventura County, Oklahoma, Colorado, and Texas.

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Radioisotopes Valuable In Petroleum Industry

Striking evidence that radioactive isotopes, made available only a few years ago through atomic fission, have already attained widespread application in industry as well as in scientific research was presented at a symposium sponsored by the American Chemical Society's New York section.

In the petroleum industry, for example, radioactive materials are now employed in virtually every operation, from drilling wells to the distribution and use of finished products, Dr. Paul H. Emmett, senior fellow of the Mellon Institute of Industrial Research, Pittsburgh, declared.

On the basis of what has been accomplished so far in the petroleum industry, "it seems safe to predict that the use of radio-isotopes will prove to be one of the most valuable tools available to research workers in the unending search for methods of producing cheaper and more useful petroleum products for public consumption," Dr. Emmett said.

In petroleum exploration and drilling operations, radio-active tracers are used to study the formations through which the drill is passing, to detect leaks in the sides of the well, and to follow the movement of oil through beds of sand, he explained.

"The insertion of a small amount of radioactive barium into successive liquids in a pipe line can be used to signal the completion of the passage of one liquid through the pipe and the beginning of a second liquid," Dr. Emmett pointed out. "In this same general field of application, tracers have been used to locate scrapers that are employed in pipes for cleaning out miscellaneous deposits."

Tracers are employed in petroleum refineries to tag individual compounds and trace them through a distilling column which is handling mixtures, it was stated. Suitable isotopes can be used in a standard radiographic procedure for measuring the extent of corrosion that has taken place in reaction vessels and piping. Even the extent to which ash is carried up the refinery stacks by combustion of oil can be measured by using radioactive ash components.

Radioactive hydrogen and radioactive carbon are particularly useful in chemical studies of catalytic cracking and polymerization processes in the production of gasoline and in the process for making synthetic rubber components, the speaker said.

"Some of the most striking applications of radioactive isotopes that have been made in the petroleum industry are related to the detection of wear in the study of lubricants," Dr. Emmett continued. "Radioactive piston rings have been employed to study the rate at which the iron from a piston ring becomes transferred to the lubricating oil. In similar experiments, tracers have been used to detect the attack of bearing materials by the lubricating oil. The amount of grease getting to a bearing in high pressure lubrication can be readily followed by Geiger counter if small amounts of the radioactive material are incorporated into the lubricant."

Lehman Brothers Buys Control of Jergins Oil

A. T. Jergins, president of Jergins Oil Company, has announced that he, C. M. Cotton, vice president, Lowell Stanley, vice president and treasurer, and certain associates have agreed to sell their stockholdings in the company to a group organized by Lehman Brothers, at a price of $421.50 per share. The holdings represent a controlling interest in the company. Under the terms of the contract, the purchasing group has agreed to make an offer at the same price to all the stockholders of the company at the earliest possible date. The transaction will involve a total of over $30,000,000.

The corporation's main activity is gas and oil production. Its principal producing properties are in the Edison, Wilmington and Signal Hill fields in California. There are other producing properties in Texas and elsewhere. Its gas reserves are chiefly in the Rio Vista field in California.

Shell Nears Completion Of Its Expansion Program

An accelerated expansion of oil distribution facilities, to raise the supply of petroleum products for both military and civilian use, will be completed by Shell Oil Company early in 1951, H. S. M. Burns, president, has announced. An important part of this expansion program, according to R. D. Stetson, Shell's Los Angeles division manager, is a products pipe line that has been constructed from Wilmington refinery to the Los Angeles bulk plant at 2015 Long Beach Avenue, where additional storage is also to be installed. Stetson said a new office, new storage, new warehouse, and fillstand have also been completed recently at San Diego.

The new nationwide facilities will add several hundred million gallons to the company's total petroleum storage and handling capacity. In addition, handling techniques have been studied and overhauled.

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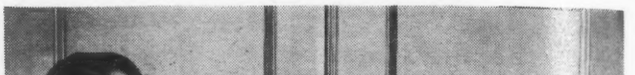
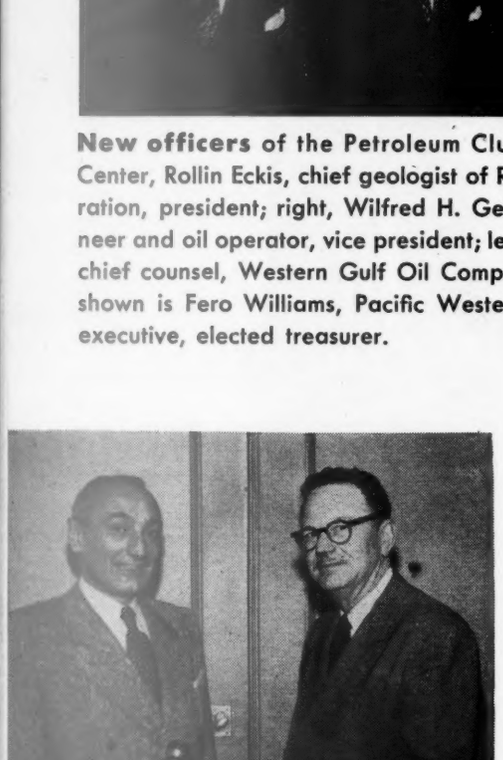
New officers of the Petroleum Club of Los Angeles: Center, Rollin Eckis, chief geologist of Richfield Oil Corporation, president; right, Wilfred H. Geis, consulting engineer and oil operator, vice president; left, James G. Leovy, chief counsel, Western Gulf Oil Company, secretary; not shown is Fero Williams, Pacific Western Oil Corporation executive, elected treasurer.

New directors of the Los Angeles Petroleum Club, S. Z. Natcher, W. H. Geis, and R. M. Barnes, elected to replace F. A. Morgan, Howard Pyle, and Mortimer Kline.





Past president of the Petroleum Club of Los Angeles, Paul Huggins, presents Henry Salvatori with a suitably inscribed gavel as a memento of his fine administration of the office in 1950. Salvatori, president of Western Geophysical Company of America, is one of the founders of the club, and Paul Huggins, vice president of Western Gulf Oil Company, is also one of the originators and was first president of the organization.

L.A. Petroleum Club Elects New Officers

Members of the Petroleum Club of Los Angeles, California, paid tribute to their outgoing president, Henry Salvatori, and welcomed a new one, Rollin Eckis, at the annual meeting in club headquarters at the Biltmore Hotel last month. The proceedings opened with President Salvatori in the chair, and after voicing a word of thanks to his assisting officers and to the membership at large for their cooperation, he called for reports from James G. Leovy, secretary; Howard C. Pyle, treasurer; Cyril Hopkinson, auditor, and P. S. Magruder, chairman of the finance committee. The reports of these gentlemen testified in all respects to the successful administration of the outgoing regime.

Magruder and Paul Huggins disclosed the progress in the matter of securing larger quarters for the club and increasing the membership roster. They made it known also that the industry looked favorably upon the expansion plans and was prepared to lend tangible support to the idea. In the course of the evening it was announced by Sam Grinsfelder that three new directors, W. H. Geis, S. Z. Natcher, and R. M. Barnes had been elected to replace F. A. Morgan, Howard C. Pyle, and Mortimer Kline whose terms had expired.

Immediately thereafter the board held a meeting and named the following officers for 1951: Eckis, president; W. H. Geis, vice president; Leovy, secretary; and Fero Williams, treasurer. In behalf of the members, past president Huggins presented to Salvatori a suitably inscribed gavel as a memento of his term of office and complimented him highly on the accomplishments of his administration.

Defends Depletion Allowance

Asserting that national survival depends upon industrial production, Robert G. Dunlop, president of Sun Oil Company, warns it would be a "tragic blunder" to tamper with the depletion allowance now granted in computing net earnings on producing oil and gas wells for purposes of income taxation. He stressed the risk entailed in building up underground crude oil reserves vitally needed for national defense. "The business of exploring for and discovering oil and gas is extremely hazardous. For example, approximately one-third of all wells drilled in the United States in 1949 were dry holes," he pointed out.

He added that in the last 25 years more than 173,000 dry holes have been drilled in the United States at an estimated cost of $5,600,000,000. In addition, the industry spent several more billions for non-producing leases, lease rentals, and geological and geophysical work on non-producing property. He explained that what the explorer gets from his producing wells must pay for his dry holes if he is to stay in business.

These special problems facing the oil producer are absent in any similar form in the manufacturing and distribution business, he asserted. He explained:

"The manufacturer does not have to build numerous factories to find one to make his product. The merchant does not have to build numerous stores before he finds one from which he can sell his merchandise. But the average producer of oil and gas must, of necessity, drill numerous dry holes to discover wells that produce."

NEWS

Katz to Give Natural Gas Lecture Series

The Department of Petroleum Engineering at the University of Kansas has announced that a series of lectures on natural gas engineering will be given by Donald L. Katz on March 26-27, 1951. The lectures are to be given on the campus of the University of Kansas at Lawrence, Kansas, and all engineers and operating personnel interested in the field of natural gas engineering are invited to attend.

These lectures have been planned as both a refresher course and to present new ideas and methods of value to engineering personnel. The program has been arranged so as to give maximum benefit to people concerned with production and transportation of natural gas in the Mid-Continent area; all methods and ideas presented will be directly applicable to gas engineering problems in that area. The lectures will cover four main topics, and each will be allowed one-half day for discussion. Main topics to be discussed are: 1. Physical and thermodynamic properties of natural gas, 2. flow of natural gas in pipes, 3. flow of gas in reservoirs, and 4. prediction of gas reserves. Those wishing to attend should write to E. A. McFarland, Manager, University of Kansas Extension, Lawrence, Kansas for enrollment blanks.

Iraq Sees Sharp Hike In Oil Output by 1955

Barring a new world war, Iraq hopes to earn more than $300,000,000 from oil royalties during the next 6 years. Iraqui officials say they expect oil production to increase from 5,500,000 tons this year to 20,000,000 in 1955. This is exclusive of new production in the Basrah and Mosul areas, which may reach 2,500,000 tons annually within the next 3 years. Iraq's oil royalties, according to unofficial estimates, may reach 2,500,000 tons or nearly $14,000,000. Production now confined to the Kirkuk fields some 650 miles northwest to the Persian Gulf, is piped to the Mediterranean.

Socony Magazine Recognized

The Flying Red Horse magazine, published by the Socony-Vacuum Oil Company, Inc., has won another award for typographical and mechanical excellence. This recognition came at the Eleventh Annual Exhibition of Printing, sponsored by the New York Employing Printers' Association, and was based upon general appearance and the quality of printing.

Armed Services Contracts Go to Sinclair Refining

The Armed Services Petroleum Purchasing Agency has just awarded contracts to Sinclair Refining Company aggregating $16,278,835. These contracts are for combat grade motor gasoline, aviation gasoline, and navy fuel oil, for delivery during the first 6 months of 1951. The combat motor gasoline will be supplied from the company's Houston and Corpus Christi, Texas refineries. Aviation gasoline will come from these two refineries and from East Chicago and Sinclair, Wyoming.

War Priorities Sought

Anticipating that defense conditions may again make it difficult for the petroleum industry to obtain supplies for full-scale operation, the Petroleum Equipment Suppliers Association has moved into action to obtain priorities and insure continuous activity in California oil fields.

In an address before the San Joaquin Chapter of the American Petroleum Institute, Roy W. Johnson, vice president and general sales manager of The Republic Supply Company, outlined the program of the suppliers under which they already have representatives conferring with the Government to avert any curtailment of operations and employment as in the past under similar conditions.

Gulf Oil to Sell Mexican Properties

Gulf Oil Corporation has announced it will sell its Mexico production holdings to the Mexican government. Spokesmen said the final sales contracts have not been signed and the amount involved was not disclosed. They stated the properties have not yielded any net return for a number of years and production during 1950 was less than 1300 bbl of oil a day. Gulf's first oil production in Mexico came in 1913.

Mexican Firm Set Up

Foster D. Snell de Mexico, S. de R. L. of Apartado 20.609, Mexico City, has been formed, according to Foster Dee Snell of the corresponding American firm of consulting chemists. It is expected that the new firm will confine its activities to consulting, development, and engineering problems in Central America, particularly in Mexico. J. Carner and J. Sperling in charge of the new subsidiary in Mexico City will be available for consultation but it is anticipated that for the present laboratory and engineering facilities at New York City and Bainbridge, New York will suffice.

Socony To Give Reward For Evidence of Sabotage

In a move to protect employees and their families and its properties from sabotage, the Socony-Vacuum Oil Company, Inc., and its two major domestic affiliates have adopted plans calling for payment up to $300,000 in rewards for evidence leading to conviction of anyone responsible for sabotage.

Socony-Vacuum and its affiliates, General Petroleum Corporation, Los Angeles, California and Magnolia Petroleum Company, Dallas, Texas have adopted plans involving up to $100,000, which each company is offering as rewards, thus bringing possible rewards to $300,000.

Socony-Vacuum announced it will pay $25,000 to anyone who voluntarily produces evidence that leads to the conviction of someone for a deliberate act of sabotage against the company when the act results in death or permanent disability.

ASLE Meet Will Feature Panel Discussion

An important feature of the 1951 National Convention of the American Society of Lubrication Engineers, April 16, 17, 18, will be an internal combustion engine panel made up of experts representing the country's largest manufacturers and users of diesel power in the marine, railroad, stationary, and high speed diesel fields.

Panel discussions will be led by W. P. Green, professor and head of engine and lubricants research at Armour Research Foundation of Illinois Institute of Technology, with high ranking authorities from the following manufacturers participating: Electromotive division of General Motors; Caterpillar Tractor; Detroit Diesel Corporation; Mack Manufacturing Company; Socony Vacuum Oil Company; Sun Oil Company, Texas Oil Company, and Worthington Pump Company.

Pancoastal Subsidiary

A new subsidiary company of Pancoastal Oil Company, C. A., will soon be formed to take over Pancoastal's large stock interests in Albercan Oil Corporation, Pan Western Oils, Ltd., and Manabi Exploration Company, Inc. Louis W. Storms, Jr., president of Pancoastal, said Canada Southern Oils Ltd., the new company, will have its main offices in Montreal, Canada, and that its president and general manager will be Cecil V. Hagen, Houston, Texas consulting geologist, and formerly chief geologist of Superior Oil Company of California.

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- ☐ 8 PROFIT MAKING FEATURES OF SYNCHRONOUS MOTORS. Pictures and describes advantages of synchronous motors direct-connected to various types of drives.
- ☐ SELECTION AND APPLICATION OF SYNCHRONOUS MOTORS. Discusses application, power factor, excitation, starting, protection, maintenance.
- ☐ HOW TO CONTROL YOUR SYNCHRONOUS MOTOR. Discusses the control for starting and synchronizing these motors and explains the polarized field frequency system.
- ☐ POWER FACTOR AND WHAT TO DO ABOUT IT. A digest on power factor calculation, the need for correcting low power factor and how it can be done.

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PERSONALS

Robert L. Minckler

▸ **Robert L. Minckler,** president of the General Petroleum Corporation, has been elected president of the Western Oil and Gas Association, succeeding **Reese H. Taylor,** president of the Union Oil Company of California, who had served as president for the past 2 years.

Other officers elected by the board of directors include **William Reinhardt,** vice president, Union Pacific Railroad Company, first vice president; **William F. Humphrey,** president, Tide Water Associated Oil Company, second vice president; **L. K. Whittier,** vice president, Belridge Oil Company, treasurer; **John M. Peirce,** vice president and general manager, and **D. S. Kilgour,** secretary.

The Association, established in California in 1906, has a membership representing approximately 90 per cent of the production, manufacture, or wholesale distribution of petroleum products in the five western states of California, Arizona, Nevada, Oregon, and Washington.

Thirty-one incumbent members of the board were re-elected. **John W. Hancock,** executive vice president of the Hancock Oil Company of California, was elected to a directorship vacated by **Will J. Reid,** president of Hancock.

After serving in the first World War and studying at the University of Washington, Minckler joined General Petroleum Corporation in 1924 as an accountant at the company's Los Angeles headquarters. Ten years later he became assistant to the president and in 1941 he was elected a director of the company. During World War II he served as Director of Petroleum Supply in the Petroleum Administration for War in Washington, D. C.

▸ **W. F. Dau,** Sinclair Oil Corporation, was elected a director to fill the vacancy caused by the recent death of **William P. Philips. Dau** joined Sinclair in 1917 as an employee of the accounting department at Chicago, Illinois. In 1921 he was transferred to the Treasury Department of the Sinclair Oil Corporation in New York where he remained until 1924, when he returned to Chicago assuming charge of the company's financial operations in that area. In 1929 he returned to New York and in 1943 was elected vice president and assistant treasurer. In June of 1949 he was elected treasurer, a position he now holds.

▸ **Fred G. Fellows,** consulting engineer, has been elected president of The Oklahoma Society of Professional Engineers. Fellows was general superintendent of the Ponca City, Oklahoma refinery for Continental Oil Company from 1929 to 1942, when he resigned to enter private practice as a consulting engineer.

▸ **J. H. Forrester** has been made manager of Stanolind Oil and Gas Company's central division. He will replace **J. E. Swearingen,** division manager in Oklahoma City, Oklahoma for the past year, who returns to Tulsa as executive assistant to **A. L. Solliday,** executive vice president.

Forrester has been manager of Stanolind's manufacturing department since January 1, 1947. In that capacity, he directed a plant expansion program that saw the construction of seven new natural gasoline and recycling plants in the 3-year period from 1948-1950. Design and construction of Stanolind's new synthetic chemicals plant at Brownsville, Texas, was also under his supervision.

Forrester joined Stanolind in 1946. Previously, he had been associate director of research and director of technical service for Standard Oil Company (Indiana). He was graduated from the University of Wisconsin with a BS degree in chemical engineering in 1928. He also holds a MS degree in chemical engineering from Massachusetts Institute of Technology.

▸ **Richard C. Harris** has been named resident manager of Atlantic Refining Company's operations in Venezuela. He will be stationed in Caracas. Harris first became associated with Atlantic in 1938 as resident geologist in its foreign producing department in Havana, Cuba. He was named chief geologist and transferred to the company's headquarters in Philadelphia, Pennsylvania in 1941, where he has served until his present appointment.

He is a native of Cando, North Dakota. He attended the University of Wisconsin, and in 1923 he was graduated from Stanford University with the degree of geological economist.

▸ **E. R. Baker** has been promoted from manager of Continental Oil Company's central research labora-

E. R. Baker

tories to assistant manager of the development and research department, Ponca City, Oklahoma. Manager of Continental's development and research department is **L. L. Davis,** who in September turned the first spade full of ground to start construction of Continental's new $2,250,000 research laboratory.

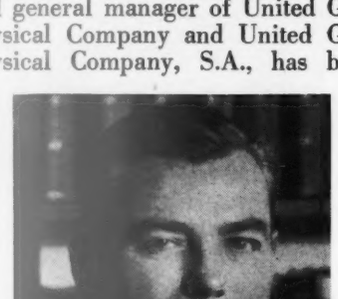
Baker, a widely experienced industrial chemist and wartime assistant research chief in chemical warfare, joined Continental in 1948 as manager of the then newly-established central research laboratories.

▸ **Rayburn L. Foster** has become vice president and general counsel of Phillips Petroleum Company, and **Harry D. Turner** has assumed the duties of assistant general counsel, vacated by Foster, and consolidated with the office of general attorney, an office already held by Turner. Both Foster and Turner are alumni of the University of Oklahoma, Foster having graduated from the law school in 1916 and Turner in 1931. Both are members of the Phi Delta Phi and the Order of the Coif, national honorary legal fraternities. Foster became a member of the Phillips legal staff in 1930. Turner joined Phillips in Oklahoma City in 1937. He was made division chief attorney in 1939, and was elected general attorney in 1949 and moved to Bartlesville.

▸ **J. Robert Tate,** promotion and advertising manager of the New York division of Shell Oil Company, has been appointed chairman of the petroleum division of the Brooklyn Red Cross 1951 fund drive. Tate is one of the approximately 50 prominent Brooklyn businessmen taking an active role in the Red Cross Campaign. Tate graduated from Hobart College in 1942 and served in the United States Navy in World War II. He joined Shell Oil in 1946.

PERSONALS

Herbert Hoover, Jr., president and general manager of United Geophysical Company and United Geophysical Company, S.A., has been



Herbert Hoover, Jr.

elected to the board of directors of Union Oil Company of California at a regular board meeting, Reese H. Taylor, president, announced. Hoover was elected to fill the vacancy caused by the death of **Ernest Stauffen,** who had been a member of Union's Board for 6 years. He will continue as the active manager of the United Geophysical Company. Hoover, who organized the United Geophysical Company, received his Bachelor degree at Stanford University and his Master degree at Harvard. He is a trustee of the California Institute of Technology and Claremont Men's College, and a director of the Southern California Edison Company.

John D. Gill, economist and director of The Atlantic Refining Company, has retired after 38 years with the company, which he joined in 1912.

Gill's first position with Atlantic was as a lubrication research engineer in the laboratory department. In January, 1928, he was appointed to head the economics department. On May 5, 1931, he was elected to the board of directors of the company, on which he served until his retirement. Gill was graduated from the University of Pennsylvania with a Bachelor of Science degree in chemical engineering in 1911.

W. R. Balfour, office manager at the Emeryville laboratories since 1942, has been named treasurer of Shell Development Company. Balfour joined Shell Oil Company at Spokane, Washington, as service station operator, and served in the Seattle, Portland, San Francisco, and Martinez Refinery offices before coming to Shell Development.

Stark Fox was elected a vice president of Oil Producers Agency at the last meeting of its board of directors, according to an announcement by Rush M. Blodget, executive vice president. Fox joined the Agency in 1937 and has been with the organization continuously ever since, except for a 3-year period during the war, when he was an air combat intelligence officer in the Navy. Prior to his association with Oil Producers Agency, he was on the editorial staff of a California oil trade publication.

C. Jared Ingersoll, prominent Philadelphia, Pennsylvania industrialist and civic leader, was elected to the board of directors of The Atlantic Refining Company. Ingersoll is president of the Muskogee Company, and chairman of the board of its subsidiary companies: The Kansas, Oklahoma, and Gulf Railroad, and Oklahoma City-Ada-Atoka Railway Company. He is a director of the Pennsylvania Railroad, Phelps-Dodge Corporation, a manager of Girard Trust Company and a trustee of Central Hanover Bank and Trust Company, New York. He is by profession a civil engineer.

Willis McGerald Peirce, assistant to the general manager of the technical department of the New Jersey Zinc Company, Palmerton, Pennsylvania, has been elected president of the American Institute of Mining and Metallurgical Engineers for 1951, and will take office on February 20 at the Institute's annual meeting in St. Louis, Missouri. At the same time, **Joseph L. Gillson,** geologist with E. I. du Pont de Nemours and Company, Wilmington, Delaware, and **Michael L. Haider,** vice president and general manager, production department, Imperial Oil Ltd., Toronto, Ontario, were elected vice presidents and directors of AIME for 3 years.

The Institute also elected 6 new directors to serve for 3-year terms: Thomas Gaunt Moore, manager, mining department, American Metal Company, Ltd.; Charles E. Lawall, assistant vice president, coal properties, Chesapeake and Ohio Railway, Huntington, West Virginia; John F. Myers, superintendent of concentration, Tennessee Copper Company, Copperhill, Tennessee; Fay W. Libbey, director, Oregon State Department of Geology and Mineral Industries, Portland, Oregon; Albert C. Rubel, vice president, Union Oil Company of California, Los Angeles; and Leo. F. Reinartz, assistant vice president and manager, Armco Steel Corporation, Middletown, Ohio.

Ken Michael, president of both the California Petroleum Retailers' Association and of the Los Angeles Service Station Dealers' Association has announced his resignation from both offices. Michael gave increased pressure of business and personal affairs as the reason for his action, and added that he will also be obliged to resign from the organizations themselves. Michael was a founding member of both organizations and has been president of each since its inception this year. No replacement has been announced as yet by either association.

Edward L. Stauffacher, Chicago, Illinois, vice president of Cities Service Oil Company (Delaware), has been appointed district chairman of the Great Lakes Oil Industry Information Committee. As such, he will direct the American Petroleum Institute's public information program in this several-state area, one of the largest OIIC districts. Stauffacher is vice president and manager of Cities Service's marketing operations and is widely known throughout the Great Lakes area.

Harrison F. Carr, veteran Louisiana oil and gas man and president of the Petroleum Club of New Orleans, Lousiana died recently following a heart attack suffered at the Sugar Bowl football game. He was 65 years of age. Carr was engineer in charge of construction of the pipe line that first brought natural gas to New Orleans, and is credited with having assisted in the development of the practice of floating lengths of pipe line through canals and ditches. For the past 23 years he was district manager in the Baton Rouge and New Orleans areas for United Gas Pipe Line Company and Union Producing Company. He retired from active service on November 1, 1950.

Rexford S. Blazer, president of 2 subsidiaries of Ashland Oil and Refining Company, has been elected president of Ashland. The subsidiaries are Allied Oil Company, Cleveland, Ohio, and Frontier Oil Refining, Buffalo, New York. **Paul G. Blazer** has been re-elected chairman of the board.

J. Howard Marshall, formerly president, was elected vice chairman of the board as an operating executive directly under the chairman. He will be relieved of detailed administrative duties to give more time for general executive activities, but will continue in charge of crude oil operations. **James L. Martin,** a director for over 30 years, was named chairman of the executive committee, a new post.

▸ **V. N. Ipatieff** of Universal Oil Products Company was unanimously elected an honorary member of the Societe Chimique de France at a recent meeting of the general assembly of the society. This honor has been conferred on Ipatieff in tribute to his outstanding scientific reputation and in recognition of his helpfulness to French scientists.

He is director of the Ipatieff high pressure and catalytic laboratory in the Technological Institute of Northwestern University. Scientific colleagues throughout the world consider him the foremost authority on the application of catalysis to the petroleum industry.

▸ **A. W. Thompson,** Houston, Texas; **Jake L. Hamon,** Dallas, independent oil men, and **D. A. Hulcy,** president of Lone Star Producing Company, Dallas have been appointed by the National Petroleum Council to study the needs of the oil and gas industries for materials and chemicals.

▸ **William C. Meek,** chief surveyor of General Petroleum Corporation's right of way department, has been elected president of the Los Angeles chapter of the American Right of Way Association. Meek is the third oilman ever to be elected to the presidency of the number one chapter of the association. R. I. Plomert, Jr., and J. J. Schillinger, both also General Petroleum executives, are past-presidents. Meek has been with General Petroleum since 1940.

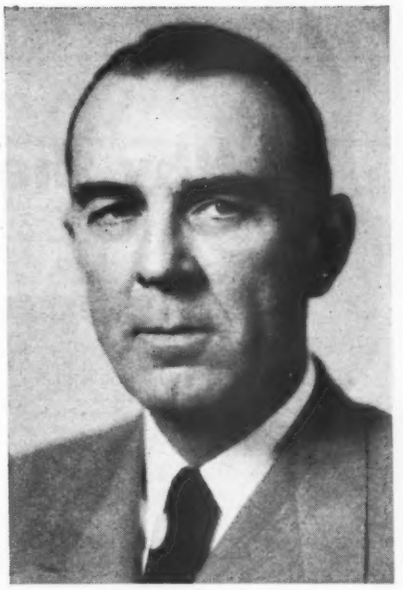
▸ **R. L. Aycock,** Pan-Am Southern Corporation, vice president, will be in charge of supply and transportation. **W. R. Remalia** will be manager of supply, reporting to Aycock, and will coordinate refinery production and product purchase arrangements with branded and bulk sales requirements.

John E. Monroe, general traffic manager, will be in charge of all distribution, reporting directly to Aycock. Monroe will also have charge of all terminals and product pipe line arrangements.

▸ **Richard G. Lawton,** president of Lawton Oil Corporation, Magnolia, Arkansas, has been named director of the production division of the Petroleum Administration for Defense, Interior Secretary Chapman has announced. Lawton organized the Lawton Corporation last August, and the company now operates in Arkansas, Louisiana, Texas, and New Mexico. He is past vice president and a member of the executive committee of the Independent Petroleum Association of America.

▸ **George L. Malherbe** has been named district manager of the newly established San Antonio, Texas office of the Department of Commerce. Malherbe was transferred from the department's regional office at Dallas to San Antonio. The new office was opened to provide service to businessmen of the area in connection with activities of the National Production Authority.

Henry J. Gruy, 1950 president of The Petroleum Engineer's Club of Dallas, presents the club charter to the new officers for 1951: (l to r) Henry J. Gruy, now a consultant in petroleum, natural gas, and geological engineering in Fort Worth, Texas; Edward C. Cram, new president, Magnolia Petroleum; Glen E. Woodward, first vice president and program chairman, DeGolyer and MacNaughton; Sam N. Dewitt, second vice president and arrangements chairman, Seaboard Oil; and H. B. Renfro, third vice president and membership chairman, J. B. Stoddard Oil Company. Not shown in the above picture is Creston H. Alexander, new secretary-treasurer, Creslenn Oil Company.



Philip H. Bohart

▸ **Philip H. Bohart,** has been elected to the board of directors of National Bank of Tulsa. Bohart is vice president of Gulf Oil Corporation. Bohart went to work for Gulf Oil in 1919 in the Texas Panhandle after having graduated from Missouri School of Mines and Metallurgy with a BS degree in mining engineering. His subsequent assignments included Wichita Falls and Breckenridge, Texas, the Republic of Mexico, Colombia, and the general Mid-Continent oil area. In 1945 he was named director of production for Petroleum Administration for War. Two years later he made a trip to Kuwait in Arabia for Gulf Oil.

▸ **John W. B. Foringer** has joined Lion Oil Company as director of industrial relations. He has been placed in charge of all matters relating to personnel and labor relations, and in this capacity he will serve as director and administrator for Lion in union negotiations. Foringer received his undergraduate education at Valparaiso University and Grove City College where he was graduated with a Bachelor of Science degree in 1928. He later received a Master of Science degree in banking and finance from Grove City College in 1929 and a Law Degree from Indiana in 1931.

▸ **Professor Cecil E. Boord,** Ohio State University professor will present an account of the hydrocarbon research program that he has directed on the Ohio State University campus for the past 12 years at the Third World Petroleum Congress at The Hague this spring. Preceeding the Netherlands meeting, he will speak before a meeting of the Petroleum Division of the American Chemical Society in Cleveland in early April.

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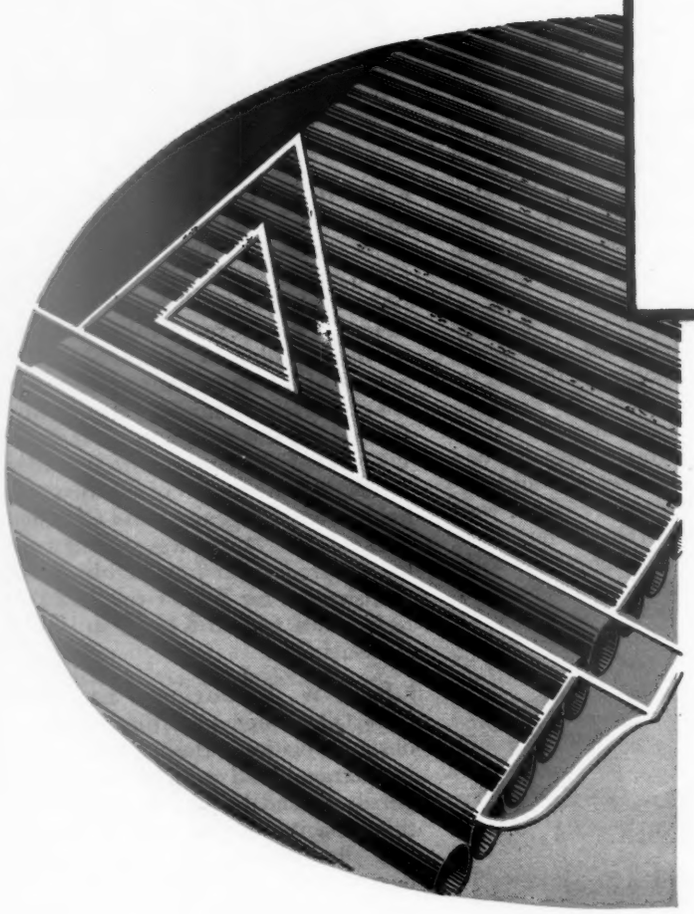

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BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

CLASSIFICATION BY ASSOCIATION MEETING

American Petroleum Institute

Twenty-Ninth Annual Meeting, Stevens Hotel and Palmer House Chicago, Illinois, November 7-10, 1949

America Unlimited, Hon. Robert S. Kerr
API Wildcatting in Some Interesting Areas, Robert E. Wilson
A Study Group Investigation of Equipment and Techniques for 20,000 Ft Drilling, John M. Payne
Basic Issues in National Transport Reorganization, Charles L. Dearing
Case History of Federal Encroachment Upon the Electric Industry, J. B. Thomas
Effects on Refinery Operations of Increasing Seasonals in Petroleum-Product Demand, Courtney Brown
Executive Development, G. B. Corless
Factors Affecting the Design of Oil-Well Sucker-Rod Strings, S. B. Sargent
Fair-Trade Laws are Necessary for Small Business, John Dressler
Field Experience with 5W Motor Oil, A. B. Anglin, Carl W. Georgi, and H. C. Mougey
Field Performance of Modern Pipe Coatings, Gordon N. Scott
Fuels — Their Present and Future Utilization, R. E. Albright, T. L. Apjohn, William M. Holaday, and L. R. Steffens
History and Development of Products Pipe Lines, John W. deGroot
Integration in American Industry, Edmund P. Learned
Let Us Be Confident, J. M. Koch
Liquid-Fuel Supplies and National Security, Walter G. Whitman
Marine Transportation in Offshore Drilling and Production Operations, Thomas Pennington and James C. Posgate
Oil Industry Information Committee in Action, Conger Reynolds
Pressure-Surge Tests on Oil Pipe Lines, J. E. Green
Radio and the Petroleum Industry, Hon. E. M. Webster
Rotary Percussion Drilling, H. E. Arnold and P. L. Guarin
Some International Aspects of Canadian Oil and Gas Development, N. E. Tanner
The Coming Impact of Natural Gas on the Fuel-Oil Market, E. Holley Poe
The History of Drilling Technology and Its Prospects, J. V. Pennington
The Legality Under the Patman Act of the Good-Faith Competition Which is Required by the Sherman Act, William Simon
The Oil Industry Looks at the Public, John M. Lovejoy
The Producer and the Pipeliner Discuss Lease-Tank Practices, R. C. Nicholson and M. H. Shanahan
The Public Looks at the Oil Industry, Claude Robinson
The Use of Ammonia in Control of Vapor-Zone Corrosion of Storage Tanks, A. T. Clothier, F. Coryell, and F. T. Gardner
The Value of Vocational Training in the Pipe-Line Industry, J. R. Mills, Jr.
Valve, Ring, Cylinder Sleeve, and Other Designs as Aids to Lubrication, A. T. Colwell and A. L. Pomeroy
Wanted: A Working Partnership for the Oil and Automotive Industries, Ray Shaw
What of Tomorrow? Admiral Louis E. Denfeld
762-Vs. 440-Volt Distribution Systems, B. L. Moore

Spring Meeting, Southwestern District Division of Production, Adolphus Hotel, Dallas, Texas, March 8-10, 1950

A Portable Resistivity Meter of Wide Range and High Sensitivity, C. S. Kuhn, P. P. Reicherts, and W. H. Wilson
Dehydration of Natural Gas, R. C. Buchan, H. H. Spain, R. J. Sullivan, and Milton Williams.
Factors Affecting the Rate of Penetration in Hard Rock Formations, W. J. Bielstein and George E. Cannon
Gas-Oil Ratio Repair and Control in West Texas and New Mexico, R. M. Hippard and T. B. Lambert
Geological Interpretation of Dipmeter Results, A. P. Claudet
Our Oil and Gas Reserves: Their Meaning and Limitations, F. H. Lahee
Permeability Studies, J. G. Heid, J. J. McMahon, Ralph Nielsen, and S. T. Yuster
Report on the Use of Lime Base Muds, Jack L. Battle and Preston E. Chaney
The Plight of American Individualism, Dr. D. M. Wiggins
The Streamlined Reorganization of the Topical-Committee Structure of the API Central Committee on Drilling and Production Practice, H. H. Kaveler
The Use of Meteorology in the Oil Industry, Richard A. Geyer and Joe E. Graham

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Applications of Emulsion Drilling Fluids in California, Thad Randolph and Doyne Wilson
A Preliminary Report on Oil Recovery by High-Pressure Gas Injection, W. F. Kieschnick, Jr. and L. P. Whorton
A Review of Gun Perforating Methods, Val L. Forsythe
A Study of the Buckling of Rotary Drilling Strings, Arthur Lubinski
Cooperative Oil and Gas Operations, Walace Hawkins
Drilling by the Turbine Method, Critchell Parsons
Pumping Deep Wells, H. E. Allen, F. M. Beal, and R. C. Curtis
Relative Economics of Diamond Coring to Conventional Coring and Drilling, C. Deely
Some Examples of In-Fill Drilling, H. H. Kaveler
The Oil Industry Has Served the Public Well, Frank Porter
Use of Plastic Pipe in Production Operations, Tom Hamilton
Vocational Training in Drilling and Production Operations, John Woodruff

Spring Meeting, Rocky Mountain District Division of Production, Gladstone Hotel, Casper, Wyoming, April 13-14, 1950

Activities of the Rocky Mountain Oil Industry Information Committee, G. F. McMillan
Applying New Techniques Through Job Design, John E. Daxon and Roger Filson
Corrosion Environments and Methods of Mitigation in Producing Sour Crude, D. A. Shock and J. D. Sudbury
Developments in the Sussex Area, Johnson County, Wyoming, E. Y. Long
Discovery and Development of Crude Oil Reserves, Cheyenne County, Nebraska, W. L. Hershelman
Oil and the Public, R. L. Minckler
Prime Movers in Modern Drilling Practices, J. E. Brantly
Significance of Pumping Rates in Squeeze Cementing, C. R. Fast and George C. Howard

Spring Meeting, Eastern District Division of Production, Hotel Cleveland, Cleveland, Ohio, April 26-28, 1950

Current Status of Secondary Recovery Research in the Appalachian Area, H. G. Botset
Introduction to Radioactivity Well Logging, R. B. Downing and J. M. Terry
Magnetic-Particle Inspection in the Petroleum Industry, W. E. Thomas
Oil in Western Canada, Dr. Oliver B. Hopkins
Patoka Benoist Water Flood—Patoka Field, Illinois, H. S. Barger
Research on Shooting Oil and Gas Wells, T. C. Atchison W. I. Duvall, Bruce F. Grant, L. Obert, and R. L. Rough
Resume of Water Flood Operations in Illinois, Indiana, Kentucky, Michigan, Ohio, and West Virginia, K. P. Huffman and R. R. Vincent
The Natural Gas Act — Must It Become a Blueprint for Chaos, J. French Robinson

Mid-Year Meeting, Division of Refining, Hotel Cleveland, Cleveland, Ohio, May 1-4, 1950

Analysis of a High-Sulfur Cracked Distillate, John F. Wilson
Constant-Volume Combustion of Diesel Fuels, K. J. Hughes and R. W. Hurn
Corrosion of Relief Valves in Sour-Crude Service, R. J. Hafsten
Description and Application of a Dual Automatic Potentiometric Titrimeter, E. B. Dunn, F. W. Melpolder, R. C. Taylor, and W. S. Young
Design of Cathodic Protection of Open-Box Type Coolers, C. R. Draughon, Jr. and E. B. McNeil
Determination of Straight-Chain Hydrocarbons by Urea-Adduct Formation, W. S. Higley, A. P. Lien, and W. J. Zimmerschied
Effects of Sulfur in Motor Gasoline on Engine Operation, J. B. Duckworth, E. J. Gay, and R. E. Jeffrey
Factors Affecting the Precision of Viscosity Measurements with the Torsion Crystal, E. D. Bailey, Jean A. Minkin, and P. E. Rouse, Jr.
Layout and Operation of New Shop—Houston Refinery, Robert Haldane
Maintenance Practices in a Small Refinery, William F. Dougherty, Leon T. Harris, John S. Pfarr, and Robert W. Pollard
Methods of Estimating Cetane Number, H. D. Young
Operation of API Oil-Water Separator at Trenton Refinery, C. F. Miller
Platformate—Properties and Performance, J. S. Bogen and Vladimir Haensel
Promoting Understanding in Industry, E. B. McConnell
Rapid X-Ray Determination of Sulfur in Distillate Fuels, Harold K. Hughes and John W. Wilczewski
Road Effectiveness of Tetraethyllead as Influenced by Added Sulfur, Wheeler G. Lovell and Donald H. Pulleyblank
Scrubbing Devices Successfully Control Air Pollution from Refinery Processes, E. P. Kropp
Supervisory Development Program at Esso Standard's Baton Rouge Refinery, H. J. Voorhies
The Behavior of Iron-Modified 70-30 Cupro Nickel Alloy in Salt Water in Some Petroleum Environments, F. A. LaQue and J. F. Mason, Jr.
The Copper-Strip Test—A Study of Current Methods of Interpretation and an Examination of Proposed New Procedures, F. W. H. Matthews and D. F. Parsons
The Effect of Hydrocarbon Structure on Road Anti-Knock Performance of Motor Fuels, M. H. Campbell R. L. Johnson, D. G. Knee, and T. B. Prickett
The Foreman in Refinery Maintenance—His Duties and a Method of Grading Him, Robert L. Rude

Spring Meeting, Pacific Coast District Division of Production, Biltmore Hotel Los Angeles, California, May 11-12, 1950

Development of Blowout Prevention and Controls, Bert L. Stone
Economic Trends of Contract Drilling in California, R. A. Powell
History of Kettleman Hills Temblor Zone Gas Injection Project, D. R. Knowlton and R. W. Masters
Oil Around the World, T. S. Petersen
Relative Permeability of California Cores by the Capillary Pressure Method, John I. Gates and W. Tempellar Lietz
The Application of Modern Clay Concepts to Oil Field Development and Exploitation, R. V. Hughes
The Use of Tubing as Drill Pipe, W. F. Bates
Well Blowouts in California Drilling Operations: Causes and Suggestions for Prevention, A. J. Horn
What's Left in America, Congressman Richard Nixon
Wilmington Field Shear Damage, Jan Law

American Society of Mechanical Engineers

Semi-Annual Meeting, San Francisco, California, June 27-30, 1949

Cylindrical Furnaces for the Petroleum Industry, O. F. Campbell
Mechanical Vibration of Piping Induced by Gas Pressure Pulsations, Raymond C. Baird and Ira C. Bechtold
ome Features of the Engineering and Design of the Trans-Arabian Pipe Line, S. P. Johnson

Petroleum Mechanical Engineering Conference

Oklahoma City, Oklahoma, October 2-5, 1949

Surge Problems in Pipe Lines — Oil and Water, S. Logan Kerr

Regional Meeting, Region VIII, Baker Hotel, Dallas, Texas, March 30-April 1, 1950

Economy Trends to Unitized Gas Compressor Installations, A. Russell Young
Lubrication Problems, B. P. Robertson
Operating Results of Gas Turbines, Otis Howard
Simplified Well Calculations, A. A. Hardy
Tidelands Seismographic Survey System, L. C. Paslay
Wood Deterioration in Cooling Towers, Donald R. Baker

Process Industries Division and Pittsburgh Mechanical Engineering Conference

Hotel William Penn, Pittsburgh, Pennsylvania, April 24-27, 1950

Design and Construction of a Fischer-Tropsch Pilot Plant, H. L. Barnebey, E. P. Lynch, and W. V. Munhall
Techniques in High Pressure Vessel Design, E. L. Clark, H. J. Kandiner, and A. M. Whitehouse

Annual Conference (Petroleum Division) Roosevelt Hotel, New Orleans, Louisiana, September 25-28, 1950

A New Method for Bulk Modulus Determinations, M. B. Gamet, S. L. Kerr, and L. H. Kessler
Attenuation of Surges in Long Pipe Lines, M. Ludwig
Extraction and Refining of Shale Oil, B. Guthrie and L. Schramm
Metals for High Pressure Hydrogenation Plants, G. A. Nelson

American Society for Testing Materials

First Pacific Area National Meeting, Fairmont and Mark Hopkins Hotels, San Francisco, California, October 10-14, 1949

Does Service Performance Justify Higher Quality Lubricating Oils, W. B. Bassett
High Detergency Motor Oils, A. B. Boehn and C. O. Tongberg
Lubrication of Marine Turbine Propulsion Equipment, F. S. Jones
Lubrication Requirements of Gas Turbine Equipment, F. C. Linn
Operating Experience and Problems Relative to Lubricating Systems of Steam Turbine Sets for Utilities, V. Estcourt
Progress Report on Ordnance Field Tests of High Sulfur Fuel in Series 2 Lubricating Oils, N. L. Klein
Specific Problems Pertaining to Lubrication of Industrial Turbines, T. N. Bath

This close-up clearly shows the ribs or corrugations which add strength to Childers Jacketing and also make it form more easily around lines. Aluminum strapping and seals are a quick, inexpensive way to attach the jacketing. They can be used without any special tools and take no special training for the installers.

Does long lasting aluminum cost too much for covering your insulated lines? Not when you specify this new type weatherproof jacketing. It has been specially developed to cost little more than ordinary temporary jacketing materials.

New Low-Cost Jacketing Cuts Maintenance on Insulated Lines

AT LAST an aluminum jacket has been "engineered" especially to protect outdoor lines in refineries and chemical plants. It is the first "permanent-type" jacketing that offers both low initial cost and low application cost.

After two years of tests and major installations at 431 outdoor locations in refineries, power plants, and chemical plants, the Childers Manufacturing Co. of Houston has rung up an impressive cost-cutting record with their Childers Aluminum Jacketing.

Secret behind this low cost is the thin aluminum sheet—.006" thick—which is the weather-protecting sheath of the jacketing. It is ribbed (as pictures show) for extra strength and to facilitate forming around the line. This aluminum has proved thick enough to resist weathering and usual abrasion, but costs much less than heavier aluminum sheets.

Easy application of this Childers Jacketing cuts labor bills drastically. It comes from the factory in easy-to-handle rolls that are four feet wide and either 100 feet or 200 feet long. It is light and flexible to handle as the men put it on the line. No roll forming required as with heavy, un-crimped material. It can be cut off and attached just the same as the old-fashioned tar-paper that was sometimes used for jacketing.

You can attach Childers Jacketing around your insulated lines by one of several easy methods. The use of aluminum strapping and seals is probably the best. Sheet metal screws or Minnesota Mining's No. 471 tape can also be used.

The Childers jacketing can be removed and re-used.

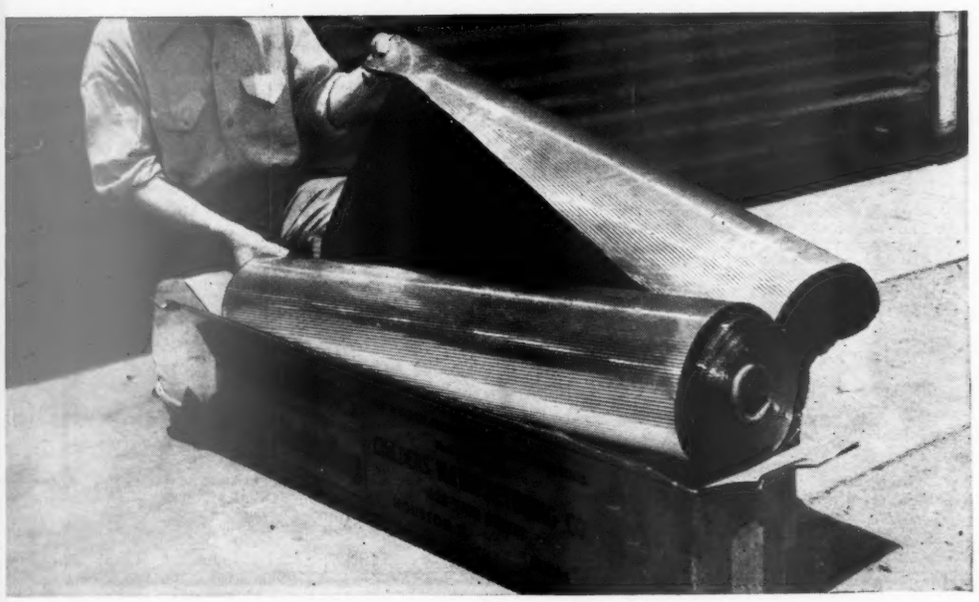
A moisture barrier is attached to the back of the jacketing to give positive protection for the aluminum when it is used with alkaline insulating materials.

No painting, no rust-proofing, little maintenance — that's the advantage of aluminum!

Hundreds of design engineers and maintenance engineers have agreed they save money for their firms and trouble for themselves by changing their jacketing specs to Childers 100%. That should make it worth your testing too — and a test roll costs only $40.00 for 400 sq. ft. (with moisture barrier attached — price for 800 sq. ft without moisture barrier $62.00). That's a good investment in any plant. (Advt.)

* * *

FOR FULL INFORMATION write Childers Manufacturing Co., Dept. EN-1, 625 Yale St., Houston 7, Tex., for complete literature. Childers has engineering representatives in principal cities to work with you on specific problems.



This is how Childers Aluminum Jacketing is shipped in easy-to-handle rolls. It is quite flexible, yet stands up under severe weathering.

BIBLIOGRAPHY—Classified list of important papers for 1949 - 1950

California Natural Gasoline Association

Bovard Auditorium, Los Angeles, California March 31, 1949

Oil Technology and Motor Fuels, Gustav Egloff

Colorado School of Mines

75th Anniversary, Golden, Colorado, September 29-October 1, 1949

Automatic Processes Control in Petroleum Refining, H. M. Schmitt
Commercial Dehydrogenation of Normal Butane, Harrison L. Hays
Correlation of Field Problems with Fundamental Research, Cecil H. Green
Correlation of Geophysical Results with Geological Structure, R. Clare Coffin
Current Trends and Progress in Mining Geophysics, Hans Lundburg
Ethylene Production by Thermocracking of Propane and Ethane Mixtures, Keith Buell, and L. J. Weber
General Factors and Consideration of Secondary Recovery Operations in the Petroleum Industry, Paul D. Torrey
Low Temperature Carbonization of Rocky Mountain Coals, V. F. Parry
New Techniques in Petroleum Exploration, G. F. Kaufmann
Operation in Hydrogen Sulphide Gas Field Near Worland, Wyoming, Robert Corbett and Max Loy
Petroleum Conservation and Conservation Laws, D. V. Carter
Petroleum in Colorado, C. E. Dobbin
Photogeology in Petroleum Exploration, R. McMillan
Pyrolytic Production of Liquid Fuels, E. W. Isom
The Drilling, Producing, and Valuation of Distillate Fields, Philip C. Dixon
The Valuation of Oil Properties for Secondary Operation, R. C. Earlougher
Well-Logging Techniques, H. G. Doll and Maurice Martin

Dallas Bar Association

Dallas, Texas, March 25, 1950

Save the Sherman Act from Its "Friends," Thomas E. Sunderland

Engineer's Council for Professional Development

Edgewater Beach Hotel, Chicago, Illinois, October 28, 1949

The Attitude of Management Toward Industrial Research, Robert E. Wilson

Illinois Society for Professional Engineers

Decatur, Illinois, January 28, 1950

Problems Requiring Engineering Society Cooperation, Gustav Egloff

Independent Natural Gasoline Association of America

Annual Meeting, Dallas, Texas, October 31, 1949

A Look Into the Legislative Future, Wesley E. Disney
Some Legal Problems of the Natural Gas Industry, Rex G. Baker
Status and Prospects of Natural Gas from the Tidelands, B. A. Hardey
The Texas "Standard Gas Measurement Law," Marshall Newcomb
Winter Supply Problems of Producers and Gatherers, G. A. Staples

Independent Petroleum Association of America

Mid-Year Meeting of Directors The Biltmore Hotel, Los Angeles, California May 8-9, 1950

Congress Looks at the Independent Domestic Industry, Russell B. Brown
Gold or Oil, Carl Coke Rister
Increased Oil Recovery by Means of Water Injection Pressure Maintenance, William L. Horner
The Value of Free and Independent Leadership, Walter S. Hallanan
The Young Man's Place in the Petroleum Industry, Clifford Cooper
Trends in Americanism, W. G. Vollmer

20th Anniversary Meeting Fort Worth, Texas October 3-4, 1949

Abstract of Report, Russell B. Brown
The Independent Operator in 1950, J. Ed Warren
The Realization of Twenty Years of Military Leadership, Walter S. Hallanan

International Acetylene Association

50th Annual Convention, Fairmont Hotel, San Francisco, California, March 27-29, 1950

Construction, Maintenance and Repair, R. D. Smith

Institute of British Agricultural Engineers

Smithfield Show, London, England, Dec. 8, 1949

Fuels for Tractor Engines, E. S. Bates

Interstate Oil Compact Commission

Summer Quarterly Meeting, Estes Park, Colorado, Sept. 1-3, 1949

Accomplishments of Conservation in Mississippi, Fielding L. Wright
The Possibilities of Secondary Recovery by Mining in the United States, Paul D. Torrey
Usurpation of State Powers by Federal Government, Frank Carlson

Winter Annual Meeting New Orleans, Louisiana December 5-7, 1949

Offshore Operations, A. L. Vitter, Jr.
Oil Recovery Research in the Oil-Producing States, George H. Fancher

Summer Meeting, French Lick Springs Hotel, French Lick, Indiana August 3-5, 1950

Economic Significance of Secondary Recovery in the Eastern States, Hon. Paul D. Torrey
Problems Relating to Conservation in the Member States, Hon. Allan Shivers

National Conference on Industrial Hydraulics

Sixth Annual Conference, Sherman Hotel, Chicago, Illinois, Oct. 18-19, 1950.

Cavitation in Piston and Gear Type Pumps, R. J. S. Pigott
The Desurger, John Howard Dawson
New Developments in Reciprocating Pumps, E. F. Wright
Volute vs Diffusion Casing for Centrifugal Pumps, A. J. Stepanoff

Natural Gasoline Association of America

Southern Regional Meeting, Tyler, Texas, October 14, 1949

The Relation of Personnel to Plant Efficiency, M. V. Cousins

29th Annual Convention, Texas Hotel, Fort Worth, Texas, April 24-26, 1950

Bubble Valves for Contact Towers, I. Earl Nutter
Centrifugal Compressors, E. A. Koenig
Cooperation Between the Oil Industry and Regulator Bodies With Respect to the Marketing of Residue Gas, Paul Kaiser
Cures for Corrosion in Gas-Condensate Wells, W. H. Stewart
Industry's Training Job, Willard G. Wiegel
Modifications in LPG Test Methods, H. A. Montgomery
Realism in Air Preparedness, Lloyd L. Turner
The Accuracy of Low Temperature Fractional Analysis of Liquid Hydrocarbon Mixtures, A. J. Miller
The Marketing of Liquefied Petroleum Gases, Kenneth Rugh
The Vapor Pressure of Liquefied Petroleum Gases, Joe F. Wood
Underground Storage of Liquefied Petroleum Gases, C. B. Johnson, Jr., V. P. Johnson and C. R. Williams

31st National Metal Congress and Exposition

Public Auditorium, Cleveland, Ohio October 17-21, 1949

Corrosion Fatigue and Stress Corrosion as Encountered in a Practical Way in the Petroleum Industry, M. E. Holmberg
Generalized Theory of Stress Corrosion, J. T. Waber

National Oil Scouts and Landmen's Association

26th Annual Convention, Shamrock Hotel, Houston, Texas, June 9-11, 1949

Offshore Drilling and Development, Mercer H. Parks
Oil Development and Problems of Alberta, Canada, Theo A. Link
Some Economic Problems of Industry, R. B. Anderson

National Petroleum Association

47th Semi-Annual Meeting, Cleveland Hotel, Cleveland, Ohio, April 13-14, 1950

Integration and Anti-Trust Policy, M. A. Adelman
Petroleum Transportation Problems—Past and Future, Harry S. Elkins
Research and Some of the Recent Developments in Specifications for Government Purchases of Petroleum Products, Charles R. Hudson, Oliver H. Landua, Edgar D. Whitley, and Ray W. Whitson
Solvent Dewaxing and Wax Manufacturing from Pennsylvania Grade Crude Oil, J. M. Hinman
The Ascending Cost of Automobile Transportation: Its Implications to the Petroleum Industry, Alexander Fraser
The Oil Industry's Public Relations, Conger Reynolds
Worldwide Lubricating Oil Production Capacity and Its Relation to Demand, Paul Keyser, Jr.

North Texas Oil and Gas Association

20th Annual Meeting, Kemp Hotel, Wichita Falls, Texas, March 25, 1950

A Year of Hydrafac in North Texas, W. E. Hassebrock and Tom E. Morton
Electrodrill Coring and Its Application to Secondary Recovery, Sergei Arutunoff
Importance of Water Selection and Treatments in Salt Water Disposal or Water-Flooding, R. C. Earlougher
Object—A Healthy Domestic Oil Industry, J. Ed. Warren
Petroleum Trends and Petroleum Hazards, Bruce K. Brown
Reservoir Engineering in Secondary Recovery, Thomas C. Canan and Donald T. May
Secondary Recovery and Stripper Well Reserves of the United States, Albert E. Sweeney, Jr.
Some Aspects of Core Analyses as They Apply to Secondary Recovery, Ray Staples
Water-Flood Survey; North Texas, Rollie P. Dobyns

Oil and Gas Law Institute

Rainbow Hotel, Great Falls, Montana June 24-25, 1949

Essentials of Petroleum Geology—With Special Reference to the Occurrence of Oil and Gas in Montana, Charles E. Erdmann
Income Tax Under Oil and Gas Operating Agreements, A. F. Lamey
Tax Planning for Oil and Gas Operators, Lessors and Lessees, James R. Felt
State Oil and Gas Leases, E. G. Toomey
Synopsis of the United States Supreme Court Decision in the Tidelands Case, E. J. Sullivan
Unitization, Its Past and Future, Dean Terrill

Pennsylvania Grade Crude Oil Association

27th Annual Meeting, Hotel William Penn, Pittsburgh, Pennsylvania, July 15-16, 1950

Current Status of Secondary Recovery Research Sponsored and Conducted by the Pennsylvania Grade Crude Oil Association, H. G. Botset
My Life as a Spy, Maria Pulaski
Petroleum Research of the Bureau of Mines, James Boyd
Quality Outlook for Pennsylvania Oils, M. R. Fenske
Recent Developments in Antitrust Law Affecting Oil Marketing, Breck P. McAllister
The Decade of Opportunity, Andrew Heiskell

Petroleum Electric Power Association

21st Annual Convention, Hotel Beaumont, Beaumont, Texas, November 17-18, 1949

Current Trends in Oil Pipeline Operation, H. H. Anderson
How Electric Utilities Have Met the Demand for Power During the Postwar Period, E. L. Robinson

To be continued

LAUGH with BARNEY

Moe and Joe were fishing in Florida waters for the first time. Suddenly Joe felt a jerk on his line. "Moe," he said, "I got me a haddock!"

"Vel," said Moe, "vy don't you take an aspirin?"

One of those benign lady settlement workers stopped a hard-looking youngster and asked where his father was.

"Ain't got no father," said the kid.

"And your mother?"

"Ain't got no mother."

"Ah, too bad. When did she pass away?"

"I never had no mother."

"Then how were you born?" the lady settlement worker asked in dulcet tones.

"Some bum played a dirty trick on my aunt!"

A notoriously nagging wife relented and bought her husband two neckties for his birthday. The husband finding them on his dresser, donned one and made a grand entrance to breakfast.

"Hummph!" snorted the nagger when she saw him. "So you didn't like the other one, eh?"

Confusion on Color: Two cab drivers met. "Hey, pal," asked one, "whatsa big idea? How come your cab's painted red on one side and blue on the other?"

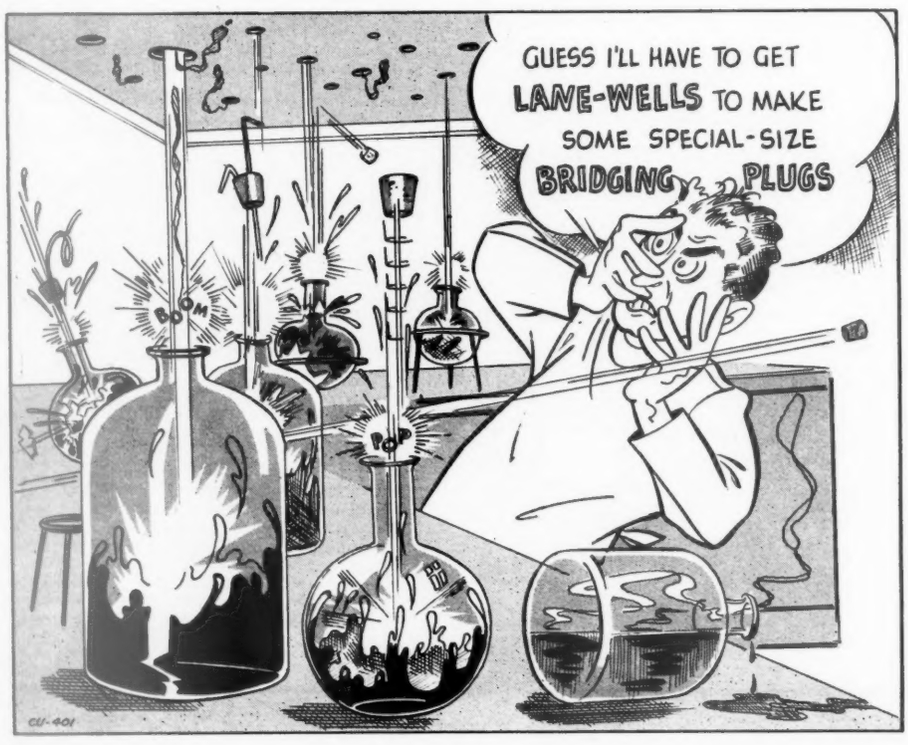
"Bub," was the answer, "it's a riot. When I gets in an accident, you should hear how all the witnesses contradict each other."

A couple of Scotsmen were walking along the road together and one was jingling something in his pocket. His pal asked "Jock, you must have plenty of money in there."

"Oh, no," said Jock, "that's my wife's false teeth . . . there's too much eating between meals in our house."

Oilman Jones was a guy who liked the "cup that cheers" a little too much, and he was finally cornered by his wife in a bar where he was dreamily contemplating a slug of rye. Being in a genial mood, he offered her a sip, but when she took it she gagged and spluttered: "How can you ever drink that horrible stuff?"

"See?" said the husband, "and all the while you thought I was having a good time."



A Negro couple applied for a marriage license.

Clerk: Married before?

Bride-to-be: Yessah.

Clerk: Husband deceased or divorced?

Bride-to-be: I deceased him.

On a dining car, this comment was delivered by the head chef to his helper who had been sent on an errand and had been gone longer than the chef liked:

"Well, you go the fudderest de quickest, and stay de longest, and do de lessest of any man I knows."

First Student Aviator: Quick what do I do now, instructor?

Second ditto: Hell's bells—aren't you the instructor?

In a night club, a gal wearing a daring low-cut gown was pointed out to Larry Finley. "That girl," said the fellow, "is wearing a $1,000 gown."

"True," answered Finley, "but her heart isn't in it."

The new "freshman" salesman was sent out to call on a customer in the next town. Upon reaching his destination, he was most embarrassed to find that he had misplaced the customer's name, and timorously he wired his office, "What is the name of our customer?"

Back came the reply. "Williams, Edgar B. Your name is Johnson, Elmer."

Sign on a Scottish golf course: "Members will kindly refrain from picking up lost golf balls until they have stopped rolling."

Heaven protects the working girl,
But Heaven, I fear is shirking.
For who protects, I'd like to know,
The fellow she is working.

Jimmie came into the school room one morning plainly excited. "Yes, Jimmie, what is it?" asked the teacher.

"I don't want to scare you," said Jimmie, hesitatingly, "but my dad said if I don't get better grades, someone is due for a lickin'."

The old mountaineer gran'paw was sitting in his favorite rocker on the front porch of his little cabin. He was rocking leisurely east and west. Sitting beside him, rocking north and south, was his youngest son Bub, an innocent little shaver of 42.

Without turning his head, the old man said: "Sonny boy, 'sno use t' wear yerself out thataway. Rock with the grain and save your stren'th."

ompare These Features...

Take a glance at the left-hand page! You are looking at the last word in well head, high-recovery, Low Temperature Separation. This equipment will increase your recovery in the stock-tank of stable condensate as much as 8 or more barrels per million CF of gas produced over conventional separation. Yes, it's another dependable, field-proven, money-saving BS&B product.

MAKE YOUR OWN COMPARISON:

- INCREASED SEPARATOR LIQUID DEPTH insures maximum stabilization for greater stock-tank recovery.
- INCREASED SEPARATOR LIQUID DEPTH reduces chance for hydrate accumulation.
- DEPENDABLE BS&B CONTROLS for trouble-free operations.
- CONCENTRIC TUBE-IN-TUBE HEAT EXCHANGER for high efficiency.
- HIGH VELOCITY CENTRIFUGAL SEPARATION gives high separation efficiency.
- BS&B TEMPERATURE CONTROL assures maximum water removal in water knock-out and constant separator temperature.
- TAILORED TO ANY OPERATING CONDITION to insure maximum operating efficiency.
- PAYS FOR ITSELF IN A SHORT TIME!
- CALL YOUR BS&B FIELD MAN RIGHT AWAY and get his story on this high-pay, low-cost unit!

Note the vertical column in the big picture: See the high frost line. BS&B engineers designed it that way. The result is increased condensate recovery in the stock-tank. Let the hydrates work for you in producing a stable product. It's the vertical liquid height that does it. Send for the bulletin — see address below. NOW!

BLACK, SIVALLS & BRYSON, INC.

Sales Promotion Dept. Section 1-22-25E

7502 East 12th Street Kansas City 3, Missouri

Sales Promotion Department

BLACK, SIVALLS & BRYSON, INC.

7502 East 12th Street Section 1-22-2

Kansas City 3, Missouri

Please rush me your new, fully-illustrated catalog on the BS&B Lo-Temperature Separator.

☐ Have Sales Engineer call.

NAME_____

FIRM_____ TITLE_____

ADDRESS_____

CITY_____ STATE_____

Oil and Gas Trade News

Glass Fibers Offices Move to Toledo, Ohio

Glass Fibers, Inc., has signed a lease for the entire second floor area of the new building being constructed at 1810 Madison Avenue, Toledo, Ohio, by The Manhattan Building Company. The floor area, totaling 7620 sq ft, will be occupied by the executive, administrative, and sales staffs of the glass concern. Space design, just completed by Bellman, Gillett and Richards, architects on the building project, features an automatic elevator, a reception room of modern decor, and a combination of solid masonry, heavy plate glass, and metal-wall partitions for the individual offices.

Mud Control to Distribute Ken-Oil Drilling Fluid

Russ J. Carlson, president of Mud Control Laboratories, Inc., Oklahoma City and William E. Stiles, division manager for Ken Corporation announce the completion of a distributor agreement making Mud Control distributors of "Ken-Oil," oil base drilling fluid. Distribution and servicing of "Ken-Oil" will be handled by Mud Control Laboratories, Inc., in Oklahoma, North Texas, West Texas, and Rocky Mountain areas.

Kaiser Aluminum Moves

The chemical division of Kaiser Aluminum and Chemical Sales, Inc., announces a change in the location of the company's sales office in Los Angeles. The new address is now 435 South La Cienega Boulevard, Los Angeles 48, California. J. T. Putnam is district manager of the Los Angeles office. The sales office's new telephone number is CRestview 6-9787.

Noel Wins Regan Award

H. M. Noel, process engineer for Esso Laboratories, Standard Oil Company, Elizabeth, New Jersey, has won the Regan Forge and Engineering Company's "International Contest". Noel correctly translated 10 Regan testimonials and identified the language used, qualifying him for the award, a 19 jewel 14 kt. solid gold case Hamilton wrist watch. Second place award winner was a senior engineering student of petroleum and mechanical engineering enrolled at the University of Texas. Three men tied for third place in the competition: Boyd L. Embry, Lion Oil Company, El Dorado, Arkansas; Clark Baker, Amerada Petroleum Corporation, Jackson, Mississippi, and Donald M. Sturznickle, The Texas Company, White Plains, New York.

Agency Moves into Larger Headquarters

Rives, Dyke and Company, advertising agency, has recently completed a move to larger and more modern offices at 2611 Sunset Boulevard, Houston, Texas. Every facility required in modern advertising techniques, both for industrial and consumer goods, is available to the company in its new offices, it was stated. Provision has been made for enlarging the present space whenever future expansion is necessary. Rives, Dyke and Company specializes in industrial advertising for service and equipment companies and other general industrial manufacturers.

Enlarge Marsh Plant

Construction is well under way for a large addition to the modern manufacturing plant of James P. Marsh Corporation in Skokie, Illinois. Measuring about 225 by 75 ft, the addition will increase manufacturing space by about 17,000 square feet. Increased demand for Marsh pressure gages, dial thermometers, radiator valves, steam traps, and other heating specialties has necessitated increased manufacturing facilities. Marsh recently acquired the Electrimatic line of refrigeration controls.

Oakite Representatives Meet. Field representatives from Canada, New England, New York, St. Louis, and the southern division of Oakite Products, Inc. attended the annual technical-sales conference held recently in New York City. Similar end-of-year conferences held in Cleveland, Ohio and Hollywood, California were attended by the company's representatives from other sections of the country.

Modernize your Manifolds with

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH TRADE MARK *Hypermatic*

PATENTS APPLIED FOR

ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania

Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N. Y.

Schlumberger to Build New Home Office, Plant

Schlumberger Well Surveying Corporation has begun construction of a new $3,000,000 home office and plant to be situated on a 36-acre tract with 900-ft frontage in the 5000 block of the Gulf Freeway, Houston, Texas. Construction will be completed in approximately one year. The new Schlumberger headquarters and plant will consist of six main buildings, which will have a total of 235,000 sq ft of floor area. An 800-ft deep test well will be drilled just outside the testing laboratory. The well will be cased with a nonconductive porous material so that oilfield electrical logging conditions can be simulated for testing of equipment. A second shallow test well will be drilled in which pressure can be built up to 12,000 psi and temperatures increased to above 300 F for testing purposes.

New Plant Triples Production Output

The new modern plant of the Flexible Tubing Corporation, at Guilford, Connecticut recently opened its doors. Frederick K. Daggett, company president, announced the program of moving from Branford and setting the wheels in motion at the new home all came off on schedule and with but a short interruption in production. Strategically situated at Guilford, Connecticut, the new plant location follows the trend of industry to build away from areas that have the possibility of A-bomb destruction. And still, being immediately adjacent to the main line of the New York, New Haven and Hartford Railroad, and major highways, products can be funneled to key markets and overseas shipping points without delay. This new plant increases production threefold.

G.E. Exhibit Train

General Electric Company's apparatus department is sponsoring a 10-car silver streamliner exhibiting some 2000 electric products, systems, and techniques. One of the purposes of the train is to stimulate greater American production through the use of electricity. Equipment aboard the train covers turbines, hydro-generators, substations, motors, complex drive systems, precise instruments, etc. C. H. Lang, vice president of sales, and C. P. Fisher, Jr., manager of exhibit train, "spot" a dummy load in the materials handling section of the G.E. special train.

Fiberglas Lays Plans For New Yarn Plant

Arrangements have been completed for building a new Fiberglas yarn manufacturing plant in Anderson, South Carolina, Harold Boeschenstein, president of Owens-Corning Fiberglas Corporation, has announced. Excavation work and site grading are beginning immediately, Boeschenstein said. Production will begin about the middle of 1951 with an initial working force of about 200 men and women employees, virtually all of whom will be recruited from the Anderson area, he reported. Decision to center the Fiberglas yarn operations in Anderson was made after studies of prospective sites.

U. S. Rubber Buys Synthetic Rubber Plant

United States Rubber Company has announced the purchase of the Buna-N synthetic rubber plant of Esso Standard Oil Company in Baton Rouge, Louisiana, as a major step in the expansion of its facilities for the manufacture of chemicals, plastics, and synthetic rubbers. The plant will be operated by the Naugatuck chemical division of the rubber company, which will continue to market Buna-N rubber under the trade name paracril.

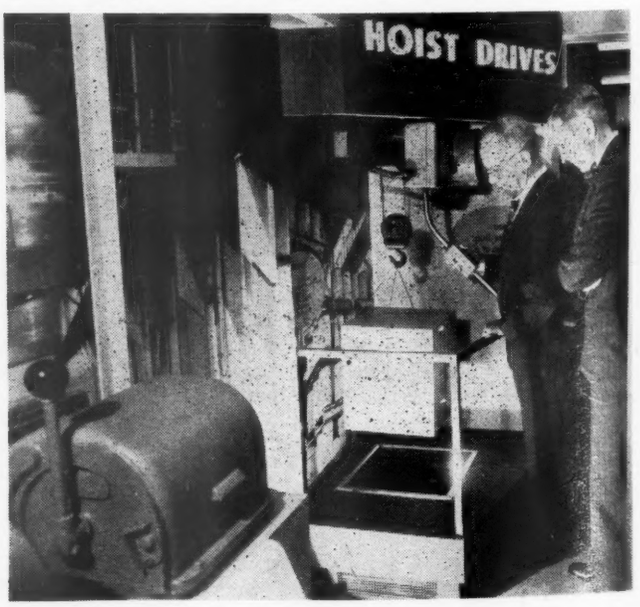
The plant now has the capacity to produce approximately 15,000,000 lb of Buna-N synthetic rubber and high styrene latex annually. U. S. Rubber plans to expand production facilities so that the plant will manufacture more than 30,000,000 lb of Buna-N synthetic rubber, high styrene latex, and the new rubber-plastic blends annually. The plant is situated on a tract of land adjoining Esso's refinery.

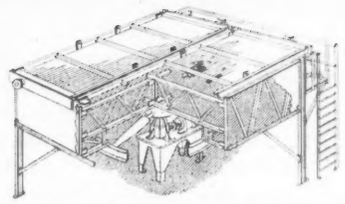
Plant, Offices Completed

Eastern Steel Tank Corporation, Flushing, New York recently completed a new plant and office. The new and modern plant covers 3½ acres on Flushing River, and greatly increases the company's production capacity. Partial list of products with which this company serves its customers includes: Stainless steel products for chemical, food, and brewing industries; specialized steel plate fabrication; ASME and non-code pressure vessels; Underwriters and Board of Standards and Appeals storage tanks for combustibles from 550 gal to 150,000 gal; and on-job-fabrication of tanks, stacks breachings, etc.

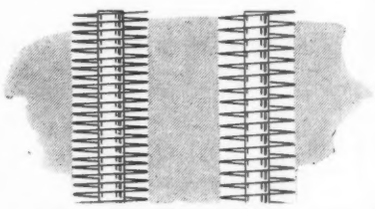
New Schlumberger headquarters and plant, which will consist of six main buildings.

C. H. Lang, C. P. Fisher, Jr. view exhibit train.

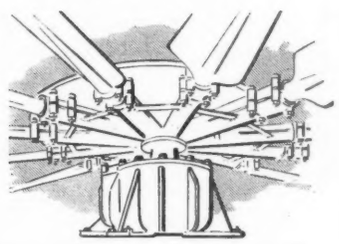




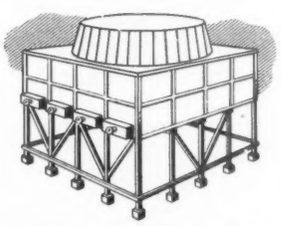
RIGID STRUCTURE . . . truss-sections give rigid but light design — requiring a small, inexpensive foundation. Rigidity assures longer-life coil sections.



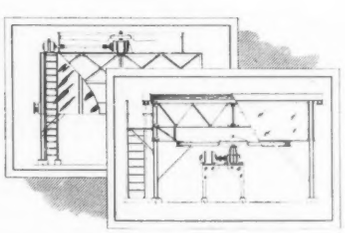
EFFICIENT FINNED TUBES . . . pressure bonded fins on tubes give high level heat transfer not dependent on solder joints. Various fins, tubes and headers available to meet any application.



PROVEN MECHANICAL EQUIPMENT . . . multibladed fans and rugged Geareducers team up to give quiet, smooth and dependable operation . . . regardless of weather or location.

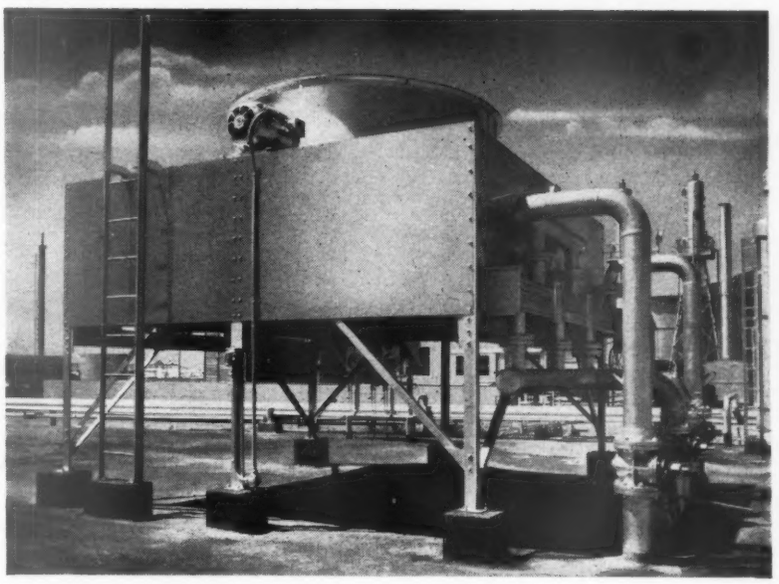


ALTERNATE MATERIALS . . . where corrosion is a problem, asbestos-board casing on a redwood frame requires little maintenance. Redwood, standard in cooling tower design, gives strong, durable and rigid support.



COMPLETE STANDARD LINE . . . induced draft or forced draft — portable or stationary — steel or redwood — various fin and tube materials and arrangements are offered by Marley to meet any application — usual or unusual.

MARLEY DriCoolers were used on the TRANSCONTINENTAL PIPE LINE because of FEATURES LIKE THESE!

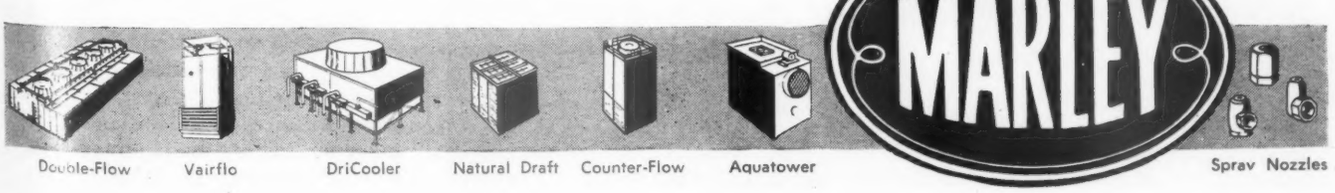


No single design in an air-cooled heat exchanger will suit all applications. Cooling jacket water in below-zero temperatures, condensing gasoline on the sea coast or serving a pipeline compressor station in the desert . . . each is an exacting application . . . each requires a different type of unit. And that's why Marley has a complete line of DriCoolers available in all sizes and in a wide range of designs and materials.

After considering all factors, such as the fluids to be cooled — first cost — horsepower cost — weather conditions — corrosion and many other factors, Marley can make the best and most economical recommendation for your job.

Whether your job requires forced draft or induced draft design, steel or asbestos-board covered redwood structures, special fin or tube materials, you can be sure that your Marley DriCooler is "Job-Engineered" for your specific application.

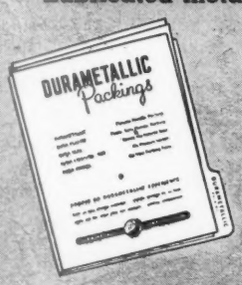
Let your Marley Application Engineer work with you from the "blueprint" stage on. Write, The Marley Company, Inc., Kansas City 15, Kans.



DURA PLASTIC *Packings*

USERS everywhere are testifying to the outstanding service performed by this general purpose semi-metallic packing. DURA PLASTIC provides improved sealing for gasoline — water — air — steam — oils and chemicals . . .

- ★ No "breaking" when formed around shafts
- ★ Remains uniform in shape under compression
- ★ Retains resiliency throughout life of its use
- ★ Lubricated metallic shreds reduce frictional wear



Write Today for Your Copy Of File No. DPPE . . .

describing types and styles of metallic and semi-metallic packings to meet your specific need.

The PERFECT SEAL

DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

MANUFACTURERS OF METALLIC and SEMI-METALLIC PACKINGS
ROTARY MECHANICAL SEALS and PACKING TOOLS

Pipe Wipers Agents

A list of distributors for Flex-Lip pipe wipers throughout the oil producing sections of the country has been released by Petroleum Mechanical Development Company of Houston, manufacturers of oil field equipment. The East Texas and Louisiana area will be served by Bob Chenoweth, 531 Neils Esperson Building, Houston. Representative in the Southwest Texas district is the Blackie Clark Well Service, 810 North Port Street, Corpus Christi. Other distributors and the areas they serve are the E. L. Oliver Company, 1241 S. E. 24th Street, Oklahoma City, Oklahoma—Oklahoma, Kansas, and the Texas Panhandle; Drill Collar Service, 609 Midland Tower, Midland, Texas—West Texas and New Mexico; and Moulden Oil Field Services, P.O. Box 1890, Casper, Wyoming—Rocky Mountains and Canada.

Petroleum Mechanical Development is owned by John E. Eckel and M. R. Jones.

Ladish Company Opens Oklahoma Branch Office

Ladish Company, Cudahy, Wisconsin, manufacturer of a complete line of forged and seamless welding pipe fittings has announced the establishment of a branch office at 405-406 Thompson Building in Tulsa, Oklahoma. The office is under the managership of G. E. (George) Mahoney who for the past three years has served as district manager for Ladish at Chicago, Illinois. Simultaneously Ladish announced a change in address of their St. Louis office and the appointment of W. H. (Bill) Heckenberg as district manager. The new office address is Suite 1605, Continental Building, 3615 Olive Street, St. Louis, Missouri.

Tube Turns Agents Named

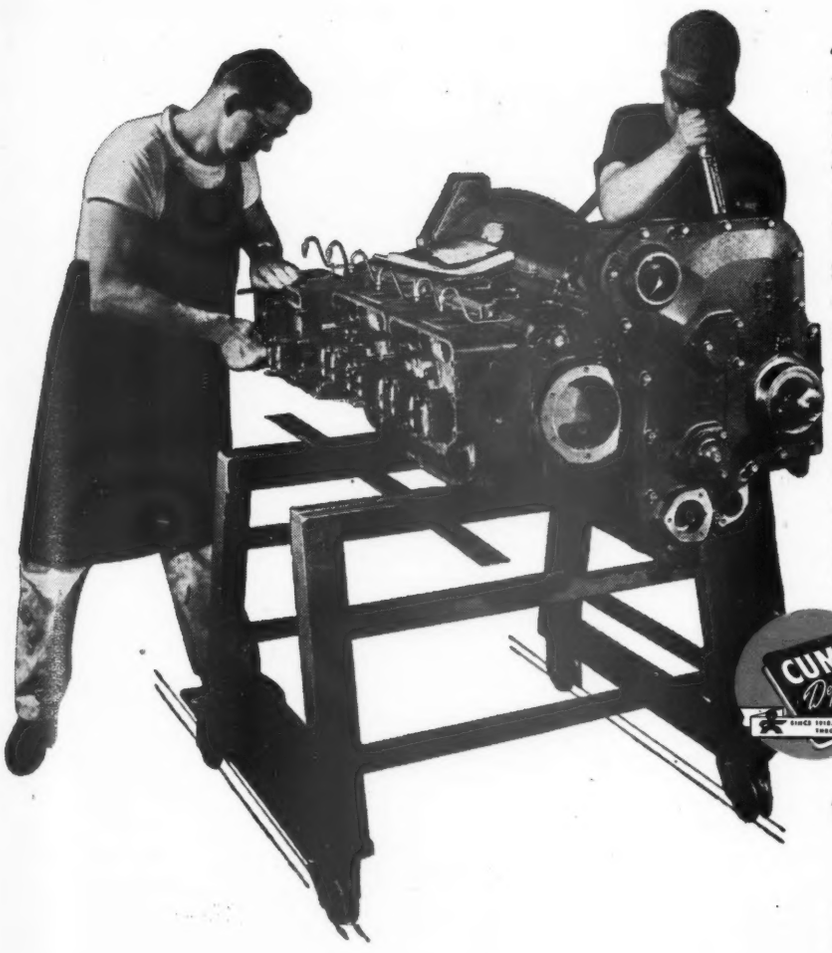
John G. Seiler, executive vice president and general sales manager of Tube Turns, Inc., has announced the appointment of the Bethlehem Supply Company and the Bethlehem Supply Company of California as distributors of Tube-Turns welding fittings and flanges. The Bethlehem Supply Company is a subsidiary of Bethlehem Steel and has its main offices in Tulsa, Oklahoma. G. A. Tompson is president and C. R. Zimmerman is executive vice president.

Bethlehem Supply of California is a subsidiary of the Bethlehem Pacific Coast Steel Corporation. Its main offices are in Los Angeles. Wendell M. Jones is vice president and general manager and J. W. Hollingsworth is general manager of sales.

Cummins® Custom-built Diesels

Built not once but Twice

Extra care in building means extra profits for power users



Typical of the extra care that goes into the building of *every* rugged, dependable Diesel is the tear-down of the engine after assembly. First the engine is run in on the test block. Then it is completely torn down and carefully re-inspected. After that it is re-assembled and tested *again*.

Such *extra* care in precision craftsmanship is one of the reasons why Cummins engines have such an outstanding record in a wide range of applications. Cummins exclusive fuel system . . . world-wide service and parts supply organization . . . are other features that enable power users to make more profit with Cummins Diesels.

There's a model engineered to fit your power needs. Contact your Cummins dealer. He has more facts to show you.

CUMMINS *Dependable* DIESEL

SINCE 1919, PIONEER OF PROFITABLE POWER THROUGH HIGH SPEED DIESELS

Diesel power by CUMMINS

TRADEMARK REG. U. S. PAT. OFF.

CUMMINS ENGINE COMPANY, INC. • COLUMBUS, IND.

EXPORT: CUMMINS DIESEL EXPORT CORPORATION
Columbus, Indiana, U. S. A. • Cable: Cumdiex

Lightweight High-speed Diesel Engines (50-550 hp) for: On-highway trucks • off-highway trucks • buses • tractors • earth-movers • shovels • cranes • industrial locomotives • air compressors logging yarders and loaders • drilling rigs • centrifugal pumps generator sets and power units • work boats and pleasure craft.

Pacific Pumps Holds Annual Sales Meeting

Pacific Pumps, Inc., held a 3-day meeting recently at Huntington Park, California, with 28 salesmen in attendance. The meeting was under the chairmanship of E. J. Weis, vice president. Special speaker's included: H. N. Mallon, president of Dresser Industries, Inc.; J. B. O'Connor, executive vice president, Dresser; A. R. Weis, president, Pacific Pumps, and other prominent industrialists. Sales, production and engineering problems and new products were discussed by various department heads.

Ladiges Moves Up

Tom Regan, president of Regan Forge and Engineering Company, has appointed Roy W. Ladiges to succeed the late Earl LeSage as purchasing agent for the company. Ladiges has been associated with Regan Forge for the past 22 years.

Pacific Pumps representatives met for a 3-day sales conference in Huntington Park, California recently. E. J. Weis, vice president of Pacific Pumps was chairman of the meeting, which was devoted to sales, production, new products, etc.

Spare the Rod and Save the Bundle!

YOU run the risk of tube damage beyond repair every time you rod-out your heat exchanger bundles.

A much safer way... a much faster way to descale your heat exchange units is to circulate hot solution of Oakite scale-dissolving compound.

Your local Technical Representative of the Oakite Petroleum Division will gladly demonstrate this time-saving, money-saving Oakite way to clean heat exchangers in-place. Send for complete details. No obligation. Oakite Products, Inc., 48 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING

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MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

NEW... 300 G.P.M. COMPACT

For Petroleum, Process and General Industries

ROPER 3600 HBRV No. 7 PUMP

Highly efficient venturi suction and discharge principle for smooth flow; deep packing box with lantern ring for effective sealing and long packing life. Case can be fitted for steam heated operation at small extra cost. Ideal for thick viscous liquids. Driven by gasoline engine, geared head motor or power take-off for wide range of applications.

Capacity, 300 G.P.M.

Send for Literature.

ROPER Rotary Pumps

GEO. D. ROPER CORP.
722 Blackhawk Park Avenue
ROCKFORD, ILLINOIS

Sales Agents Named

Three new sales representatives have been appointed by Double Seal Ring Company of Fort Worth, Texas. The new sales representatives and their territories are: Alton J. Fabrey, eastern New York; Clifford J. Lane, western New York; and the C. H. Garrison Company, Kansas and southwestern Missouri. Ranking veteran of the group is Lane, who has worked for 25 years in the engineering field. Next in engineering experience is C. H. Garrison, head of the Kansas City firm bearing his name, who has been in the engineering field 15 years. Fabrey, of Scotia, New York, has 12 years' experience in selling industrial equipment and precision parts. Each of the new representatives is the exclusive seller in his territory of all products, except railroad rings, of Double Seal.

National Supply Pump Good After 23 Years

Twenty-three years and still going strong is a pump Ohio Oil Company has been operating in its pipe line department at Byron, Wyoming. The pump, a National Supply Company Ideal 6¾ by 14, first saw service as part of an electrified rig in the Oregon Basin field in 1927. On its first job the Ideal pump was equipped with an electric motor mounted on top of its frame behind the fluid end. It was used on the Wilson No. 1 well in the Oregon Basin field and then was moved to Byron, having seen some service at Dry Creek in Montana. Initially it was equipped with a 35 hp engine; but when this arrangement failed to supply enough power, a larger engine was installed. Since then the pump has run continuously.

Foreign Made Diesels To Be Marketed in U. S.

Single cylinder and 2-cylinder air-cooled diesel engines, manufactured by the Armstrong-Siddeley Group, will be marketed by Lister-Blackstone, Inc., of New York, through a recent agreement between two companies. This is the second agreement between Armstrong-Siddeley and an American firm. Curtiss-Wright Aeronautical Corporation last month entered into an agreement to produce the Armstrong-Siddeley "Sapphire" turbo-jet aircraft engine, the world's most powerful aero-engine.

Lister-Blackstone's arrangement will make available to American diesel power users the Armstrong-Siddeley single cylinder model developing 8 hp at 1500 rpm, and 2-cylinder model developing 20 hp at 1800 rpm. Both models have bore and stroke dimensions of 4¼ in. by 4¼ in. The 2-cylinder 20 hp engine represents the highest-powered air-cooled diesel ever sold in the U.S.A.

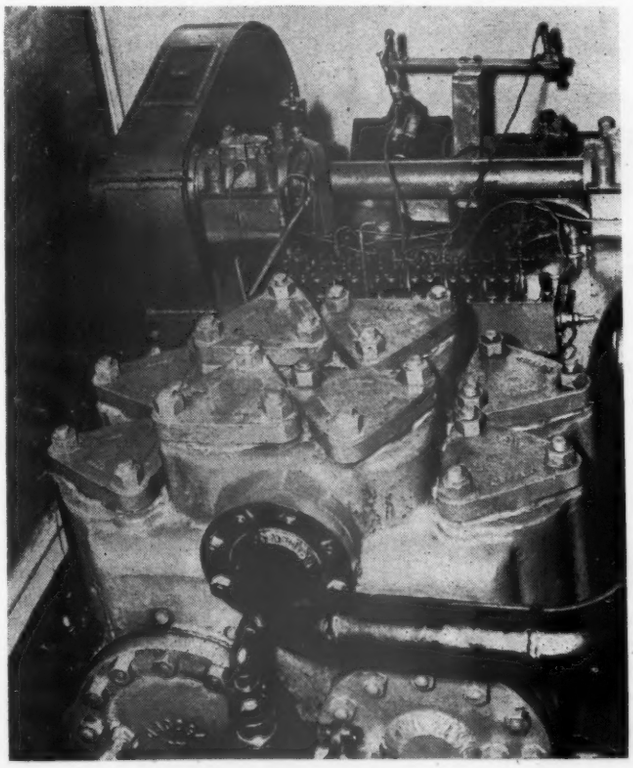
Thermal Is Distributor

The Johnson Corporation of Three Rivers, Michigan, manufacturers of steam specialties and boiler room equipment, have announced the appointment of The Thermal Industrial Engineering Company of Denver, Colorado, as new district representatives. Thermal Industrial, with Frank T. Settle, president, is well known to the trade. It will represent the Johnson Corporation in Colorado and Montana, eastern Wyoming, western Nebraska, western Kansas, and northern New Mexico. Their offices are situated at 1932 Cherry Street, Denver 7, Colorado. The new Johnson representatives have been specialists in boiler room equipment for some time.

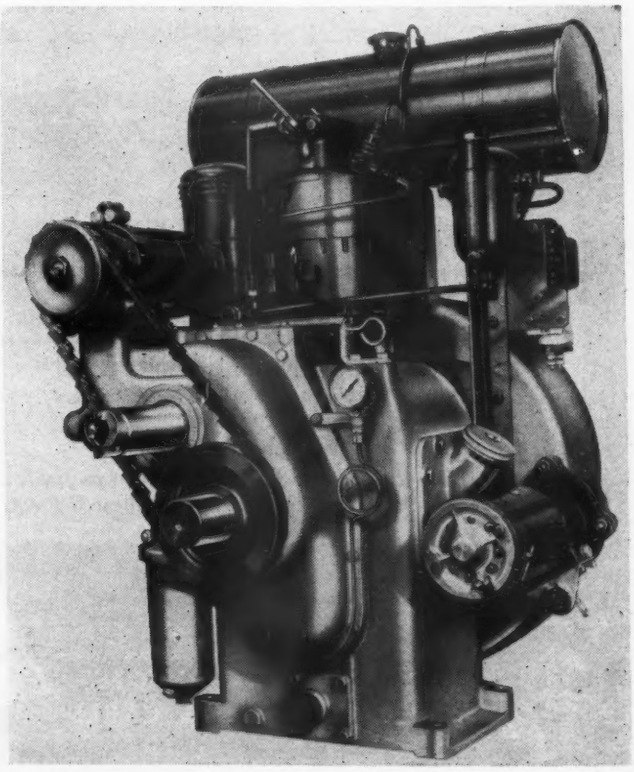
Acquires Wintroath Pumps

H. C. Ramsey, president of Worthington Pump and Machinery Corporation of Harrison, New Jersey, has announced the acquisition by Worthington of Wintroath Pumps Inc., of Alhambra, California, and stated that the Wintroath Company will operate as a wholly owned subsidiary of Worthington, continuing under present management with Boyd Kern remaining as president. Organized in 1929, Wintroath has become one of the leading manufacturers of vertical turbine well pumps, a type used extensively in irrigation projects.

National Supply pump used by Ohio Oil.



Foreign made diesel sold by Lister-Blackstone.



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VALVES

NO. 6056
Forged
Steel
Gate Valve

Here is a Premium Valve that is NOT premium priced

CHECK THESE DESIRABLE FEATURES:

- Bolted bonnet construction
- Heat-treated and hard chrome plated stainless steel wedge
- Stainless steel gland eye-bolts and nuts
- Two-piece gland and follower
- Tongue and groove bonnet joint

It's well designed. It's low priced in its field.
See your R-P & C distributor or write nearest R-P & C district office.

ACCO
Reading, Pa., Atlanta, Baltimore, Boston, Chicago, Denver, Detroit, Houston, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

R-P & C VALVE DIVISION
AMERICAN CHAIN & CABLE

"Intentionally Better"
READING-PRATT & CADY VALVES

Worthington Acquires Oil City Property

E. J. Schwanhausser, executive vice president of Worthington Pump and Machinery Corporation, Harrison, New Jersey, has announced that Worthington has acquired the land, buildings, and equipment of National Transit Pump and Machine Company in Oil City, Pennsylvania, which is in process of dissolution, and the sale of these assets is in connection therewith. Schwanhausser said that this plant, covering about 500,000 sq ft, will be utilized by the corporation in furtherance of its production of equipment related to the National Defense Program. It is expected that Worthington will take possession of the plant early in this month and commence operations about that time.

Le Beau Attends Rio Show

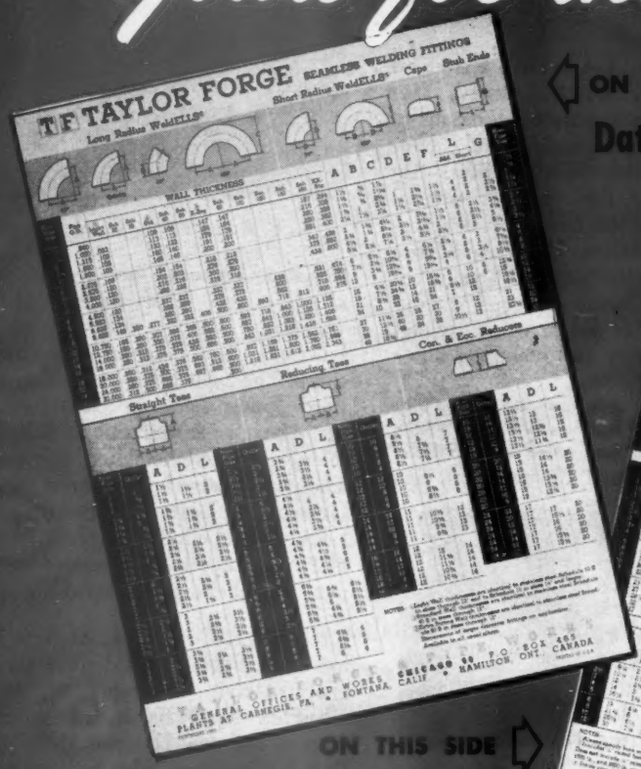
Among the prominent representatives of North American manufacturers of power equipment attending the first South American Road Show, January 5 to 21 at Rio de Janeiro, was Irving Le Beau, export sales manager of Wisconsin Motor Corporation, Milwaukee, Wisconsin. Following attendance at the Road Show, Le Beau's travel itinerary included a two months' tour of Latin American countries, visiting Wisconsin engine distributors in southern Brazil, Argentina, Paraguay, Uruguay, Chili, Peru, Ecuador, Columbia and Venezuela.

Corning Glass Works To Commemorate 100th Year

Amory Houghton, chairman of the board of Corning Glass Works has announced the company will commemorate its hundredth anniversary in 1951. Houghton emphasized that glass has been widely used by man for more purposes than any other material and that it enters into every aspect of living. Ancient as it is, however, the glass industry has seen its greatest developments in recent generations. Some of Corning's outstanding achievements have been the first practical bulb for Edison's electric lamp, the development of Pyrex brand heat resistant glass, the casting of the 200 in. telescope disc and the mass-production of glass for television picture tubes. Scientific research in glass has greatly augmented the number of uses for glass in science, industry and the home, and continues to uncover new applications and developments.

The Glass Works was founded in Somerville, Massachusetts, in 1851, as the Union Glass Company by Amory Houghton, great-grandfather of the present chairman.

Yours for the asking—


T F TAYLOR FORGE SEAMLESS WELDING FITTINGS
Long Radius WeldELLS
Short Radius WeldELLS
Caps
Stub Ends
WALL THICKNESS
Straight Tees
Reducing Tees
Con. & Ecc. Reducers
GENERAL OFFICES AND WORKS CHICAGO 90 P O BOX 485
PLANTS AT CARNEGIE, PA. FONTANA, CALIF. HAMILTON, ONT. CANADA

ON THIS SIDE

Data on the WeldELL line

T F TAYLOR FORGE ASA FORGED STEEL FLANGES
150 LB FLANGES
300 LB FLANGES
400 LB FLANGES
600 LB FLANGES
900 LB FLANGES
1500 LB FLANGES
2500 LB FLANGES
WELDING NECK FLANGE BORES
GENERAL OFFICES AND WORKS CHICAGO 90 P O BOX 485
PLANTS AT CARNEGIE, PA. FONTANA, CALIF. HAMILTON, ONT. CANADA

ON THIS SIDE

Data on Taylor Forged Steel Flanges

A VOLUME OF DATA

. . . covering welding fittings and forged steel flanges . . .

ON A SINGLE SHEET

Here is just about the handiest tool ever devised for the pipe designer. Data on welding fittings and flanges that otherwise could be found only by plowing through many catalog pages and tables have been ingeniously condensed on the two sides of the durable letter-size card illustrated above.

One side covers the broad WeldELL line of Taylor Forge welding fittings. For every nominal pipe size, ½" through 30", it shows the wall thickness for every weight of every fitting in every available material. It also shows all required dimensions of all types of fittings.

The other side covers the world's most complete line of forged steel flanges. For every nominal pipe size, ½" through 24", it gives all essential dimensional and bolting data for all types of flanges in all weights. A particularly useful table (see reproduction) is that showing welding neck flange bores which enables you to determine the I.D. of any nominal pipe size without separate calculation. Thus the sheet gives you O.D. and I.D. of any weight of pipe.

The card is varnished to make it stand the steady usage you are certain to give it. To obtain your copy see your Taylor Forge distributor or **MAIL THE COUPON.**

T F

TAYLOR FORGE

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General Offices and Works: P. O. Box 485, Chicago 90, Ill.
Offices in all principal cities.
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

Please send me one of your fitting and flange sheets:

NAME_____

POSITION_____

COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

508-0251 Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.

Trade Personals

▸ **Robert A. Miller** has been appointed sales manager, gear coupling division, Sier-Bath Gear and Pump Company, Inc., North Bergen, New Jersey. Miller, previously advertising manager for the company and assistant sales manager of the coupling division, is now in charge of appointing representatives for the company's new line of flexible gear couplings.

R. A. Miller

▸ **J. J. Carlson,** assistant general sales manager of Kaiser Steel Corporation, has been promoted to the post of general sales manager. Joining Kaiser Steel in 1944 after several years with Inland Steel Company, Carlson has served in several sales capacities. In 1945 he was sent to Seattle as manager of sales for the Northwest district and in 1947 was transferred in the same capacity to Los Angeles.

▸ **W. H. Woleben** was transferred from the Chicago Bridge and Iron Company's general sales office in Chicago, Illinois to its Houston, Texas, sales office recently. Woleben worked in the Chicago Bridge and Iron Company's drafting room in Birmingham, Alabama, from June, 1948 until March, 1949 when he was transferred to a field erection crew.

▸ **Thomas H. Trower,** prominent Tulsa, Oklahoma, attorney and war veteran, has been elected treasurer of the Bovaird Supply Company of Tulsa. A native of Bartlesville, Trower entered the army after graduating from the University of Oklahoma in 1942. He joined John H. Poe in the practice of law in 1946, and has been associated with the law firm of Williams, Boesche and McDermott since August, 1947. Trower has been rather closely associated with the oil industry. His father, Harry A. Trower, has been vice president of Phillips Petroleum Company at Bartlesville for many years.

Thomas H. Trower

▸ **Brigadier General Edward Montgomery, U. S. Army, Retired,** has been appointed assistant to the executive vice president of Chemical Construction Corporation. He will coordinate the work of several departments of the company in addition to other duties. He retired from the Army in 1949 after 23 years of duty with the Chemical Corps, during which period his duties were divided between executive and technical sides of the service.

▸ **John R. Gephart,** for 16 years associated with the sales department of Harrisburg Steel Corporation, has opened his own business as a sales representative with offices at 100 Park Avenue, New York 17, New York. Thus far, Gephart has announced representation for the following firms and lines: U. S. Wolfson Brothers Corporation, New York City; Gordon Machine and Tool Company, Inc., Philadelphia, and Buxton-Maher Company, Newark, New Jersey.

J. R. Gephart

▸ **K. C. Tomlinson,** affectionately known as "Tommy" Tomlinson by his many friends in the gas industry, died on November 14. At the time of his death, he was manager of American Meter Company's Pacific meter works. Tomlinson was employed by the Portland Gas and Coke Company up to the time of the first world war, during which he served with the United States Air Corps in France. In 1926, he joined American Meter as engineer, and in 1935 he was appointed Pacific Coast manager.

▸ **J. D. Hipple** of Skelly Oil Company has joined the sales force of Knight Manufacturing and Supply Company of Tulsa, Oklahoma. Hipple, 28 years in the purchasing and materials department of Skelly, will serve the purchasing departments of the industry in the Tulsa market. He is a member of the Tulsa Purchasing Agents Association.

J. D. Hipple

K. E. Appert G. M. Lebedeff

▸ **Kurt Appert,** vice president and chief engineer of Lenkurt Electric Company since its founding in 1934, has been made director of engineering there. The San Carlos, California company manufactures wire-line and radio carrier equipment for telephony, telegraphy, telemetering, and control. The post of chief engineer is taken by **George M. Lebedeff.** Before joining Lenkurt, Lebedeff was chief engineer at Heintz and Kaufman and an engineer with Federal Telegraph.

▸ **Ralph J. Cordiner,** of New York, has been elected president of the General Electric Company to succeed **Charles E. Wilson,** named chairman of the new Defense Mobilization Board. Cordiner, who has been associated with General Electric for 24 years and has served as manager of 5 of the company's departments during that period, has been executive vice president and a director of the company since 1949. The retiring president completed 51 years of continuous service with General Electric in November. Beginning as a messenger boy with the Sprague Electric Company in 1899, later to become a part of General Electric, he rose to the presidency in 1939.

▸ **Wilbur R. Leopold** has been appointed assistant to T. Cruthers, vice president of Worthington Pump and Machinery Corporation, Harrison, New Jersey, and will function on public works projects. He was formerly manager of Worthington's Detroit office. Leopold began with Worthington in 1917 as a sales trainee in the meter shop in Harrison and later that year he was appointed to meter salesman in the New York office. **Clarence S. Wentworth** will fill the post of manager of the Detroit office. After graduating from Northeastern University in 1922 with a BME degree, he joined Worthington.

W. R. Leopold

Republic National Bank of Dallas

Statement of Condition, December 30, 1950

RESOURCES

Cash and Due from Banks	$139,309,919.87
U. S. Government Securities	56,947,845.52
State, Municipal and Other Securities	5,873,152.77
Stock in Federal Reserve Bank	825,000.00
Loans and Discounts	191,670,662.29
Bills of Exchange and Commodity Loans	38,035,372.42
Bank Premises and Equipment	2,336,588.35
Real Estate for Bank Expansion	2,423,241.69
Acceptances—Customers Account	9,713,999.33
TOTAL	$447,135,782.24

LIABILITIES

*Capital	$ 13,500,000.00	
*Surplus	14,000,000.00	
Undivided Profits	3,573,588.88	31,073,588.88
Reserve for Contingencies		2,503,728.19
Reserve for Taxes, Etc.		2,585,981.31
Acceptances—Customers Account		9,713,999.33
Deposits:		
Individual	255,581,674.26	
Banks	140,918,198.93	
U. S. Government	4,758,611.34	401,258,484.53
TOTAL		$447,135,782.24

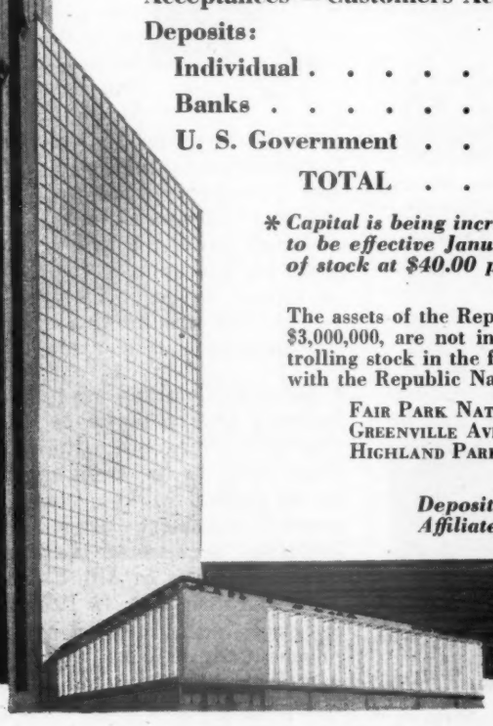
** Capital is being increased to $16,000,000 and Surplus to $16,500,000, to be effective January 8, 1951, by sale of 125,000 additional shares of stock at $40.00 per share, amounting to $5,000,000.*

★ ★ ★

The assets of the Republic National Company, including its capital stock of $3,000,000, are not included in above statement. The Company owns controlling stock in the following banks located in Greater Dallas, all affiliated with the Republic National Bank:

FAIR PARK NATIONAL BANK — LAKEWOOD STATE BANK
GREENVILLE AVENUE STATE BANK — NATIONAL CITY BANK
HIGHLAND PARK STATE BANK — OAK CLIFF BANK & TRUST CO.
OAK LAWN NATIONAL BANK

Deposits of the Republic National Bank and Affiliated Banks aggregate $498,026,471.84



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

▸ **J. Arthur Moore** has joined Ralph Ruse as a partner in the Diamond Drilling Company, with offices in Compton, California. For the past year and a half, Ruse has represented Drilling and Service Company of Dallas, Texas, on the West Coast, handling Truco diamond bits and D & S core barrels. This service company sells and rents equipment or contracts for diamond coring on a footage basis. It is also the world sales representative for Soll Telescoping core barrel. Moore was one of the founders of Oil Base, Inc., Compton, and served as vice president in charge of sales for that company for 5 years. He was with Baroid, prior to the formation of Oil Base, Inc. Ruse represented Oil Base, Inc., in California, the Rocky Mountains, and the Mid-Continent.

J. A. Moore

▸ **Dan D. Williams,** district manager of the Whitney Chain Company's Philadelphia, Pennsylvania, office died December 18, 1950. He was associated with Whitney Chain for 19 years.

▸ **W. A. Neumann, Jr.,** has been named manager of the IMO-De Laval products division, De Laval Steam Turbine Company. In this capacity he will be responsible for the engineering and sales of the company's line of power transmission equipment and rotary pumps. He has served as acting manager of this division for the past year. In addition to his new responsibilities, Neumann will continue as assistant treasurer of the company. He previously held the position of controller. Prior to his association with the company in 1946, Neumann was with the Westinghouse Electric Corporation, Pittsburgh, Pennsylvania, for 9 years.

W. A. Neumann

▸ **M. F. Hazel** has been appointed director of engineering for Oil Well Supply Company, U. S. Steel subsidiary. **Alex Quayle** was made chief engineer in charge of all product design. Hazel has served as Oilwell's general manager of sales since 1948. He joined the company in 1930 following graduation from Pennsylvania State College. Quayle has been chief engineer in charge of product design at Imperial Works, Oil City, Pennsylvania, Oilwell's principal manufacturing plant. In his new position he will be situated at the company's home offices in Dallas. A graduate of Stevens Institute of Technology, Hoboken, New Jersey, he joined Oilwell in 1936.

T. H. Creden

W. D. Wood

▸ **T. H. Creden,** eastern district tubular products sales manager for A. O. Smith Corporation, was appointed assistant manager of A. O. Smith's tubular division at Milwaukee, Wisconsin. In his new assignment he will aid Dennis F. McCarthy, division manager, whose responsibilities have been expanded to include those of vice president and general manager of A. O. Smith Corp. of Texas, operators of a new pipe mill at Houston. Creden joined A. O. Smith in 1935. Succeeding him in New York is **Walter D. Wood,** who moves from the post of Boston branch manager, where he headed sales of A. O. Smith products. **J. J. Bohmann,** coordinator of distribution and sales, will continue in this capacity in handling of customer contacts.

▸ **George H. Loving** has been appointed director of sales of du Pont's explosives department, succeeding **Charles B. McCoy,** who was transferred to the electrochemicals department as assistant general manager. Loving joined the du Pont Company in June, 1930, as a chemist. He was made a special assistant to the director of the chemical division of the explosives department in 1939.

▸ **William E. Stiles,** has resigned as director of sales for Core Laboratories, Inc., to become associated with Ken Corporation, Long Beach, California. Stiles, with headquarters in Dallas, will manage the manufacturing and sales of "Ken-Oil" outside of the state of California. "Ken-Oil" is an oil base drilling fluid.

W. E. Stiles

▸ **A. G. Hendrickson** has joined A. O. Smith Corporation as welding equipment sales manager. He will function under **L. F. Vonier,** welding division sales manager who until now had actively managed sales of both welding electrodes and welding machines. Hendrickson comes to A. O. Smith from the Harnischfeger Corporation where he was assistant manager of welder sales.

A. G. Hendrickson

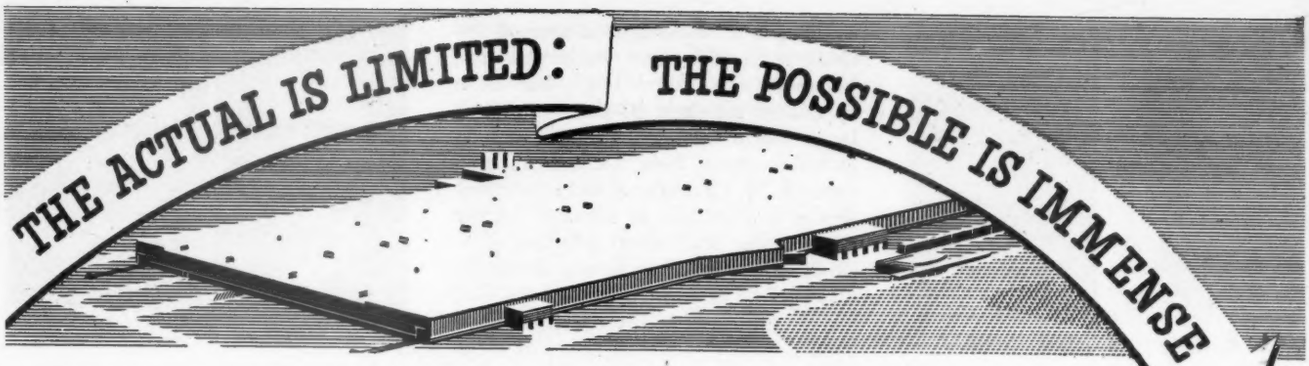
▸ **J. S. Johnson** has been appointed assistant to the president of United States Rubber Company. He succeeds **G. R. McNear,** who has been elected a director and the managing director of the North British Rubber Company, Ltd., Edinburgh, Scotland, in which U. S. Rubber is a substantial stockholder. Johnson, a native of Middleboro, Massachusetts, has been with U. S. Rubber since 1931. During World War II he was loaned to the government to head the tire division of the War Production Board.

▸ **Paul M. Arnall** has been elected president of The Lunkenheimer Company of Cincinnati, Ohio. He succeeds **Frank P. Rhame,** who resigned. Rhame, affiliated with Lunkenheimer for 32 years, will continue as a director and in an advisory and consulting capacity with the 88-year-old valve firm. He was appointed Lunkenheimer president in 1945 and was previously vice president in charge of sales engineering.

P. M. Arnall

Arnall joined the firm a year ago. After his education at the University of Kansas, he began his business career in 1920 with the Graton & Knight Company of Worcester, Mass.

▸ **John F. Costigan** has been named assistant works manager of Allis-Chalmers Norwood (Ohio) works. Since 1945, he had been an assistant to the general works manager of the general machinery division's manufacturing department. Costigan entered the employ of Allis-Chalmers in 1918 as a machinist. In 1920, he was assigned to the material control department. In 1940 he became superintendent of production scheduling, retaining that post until he was named an assistant to the general works manager at West Allis in 1945.



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LATEST WELDING TECHNIQUES for all types of joints and metals are available in the new 9th Edition "Procedure Handbook of Arc Welding Design and Practice." Includes data on welding speeds and costs. Price only $2.00 postpaid in the U.S.A.; $2.50 elsewhere.

Restores Ring Grooves of flanges by adding weld beads of "Stainweld A5-Cb" electrode and finishing with pass of "Stainweld D" electrode for machineability.

New Lining for high pressure exchanger is fabricated from 8" wide strips of 16 gauge stainless steel, plug welded to the exchanger with "Stainweld" electrode and then weld assembled with continuous butt welds.

Adds Adapter Assembly to 30,000 gallon tank. Cut from ¾" plate and 24" pipe, the adapter is clamped to tank and fillet welded with "Fleetweld 5".

for prolonging life of equipment

Reclaims Valve Body whose inside wall is corroded ½" by building up area with "Stainweld D" electrode (25% chromium—20% nickel).

for fabricating special equipment

Adds Steam Jacket for valves used on asphalt lines. Splices piece of 3" pipe after coping out V's, bending and welding with "Fleetweld 5" electrode. Nipples are ¼" pipe fillet welded to jacket.

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THE LINCOLN ELECTRIC COMPANY

CLEVELAND 1, OHIO

E. R. Rudy

T. Alexander

Earl R. Rudy has been appointed district manager of Franks Manufacturing Corporation sales and service branch at Mt. Vernon, Illinois. **Tommy Alexander** has been appointed service manager under district manager **Kenneth Laner** at Frank's Odessa branch. Both men have had extensive experience in Frank's assembly shop, modification shop, and service department.

G. R. McNear has been elected a director and the managing director of North British Rubber Company, Ltd., Edinburgh, Scotland. He has been assistant to the president of United States Rubber Company, which is a substantial stockholder in the British company. McNear, a native of Auburndale, Massachusetts, has been with the company since 1933. Previous to his appointment as the president's assistant in 1949 he had held positions in the manufacturing and sales departments of the tire division.

Arthur W. Dale, 53, general manager of sales of the mining division of Gardner-Denver Company died suddenly, on December 18, in his office at the company's plant in Quincy, Illinois. Dale had been associated with Gardner-Denver Company since 1916. He first worked in the Denver plant of the company, and then for a number of years he was manager of the Pittsburgh office.

Joseph F. Eckel, manager of the General Electric river works at Lynn, Massachusetts, since 1947, has been appointed manager of the company's large motor and generator divisions at Schenectady, New York. Eckel succeeds **J. M. Crawford,** recently transferred to Pittsfield as manager of the transformer and allied product divisions. **Herbert L. Ross,** formerly manager of manufacturing of the G-E meter and instrument divisions, has been named to succeed Eckel as river works manager.

Roy H. Langford, International Derrick and Equipment Company, has been appointed district manager for the State of Oklahoma. His office will be in the Kennedy Building, Tulsa, Oklahoma. Roy joined Ideco in 1948 as Tulsa city sales representative. Beginning in the oil patch in 1931 as a roughneck he first joined an oil-field supply company in 1935.

R. H. Langford

E. E. "Bill" Williams has been added to the export sales department, Technical Oil Tool Corporation, Ltd. Williams has been in Bakersfield, California for the past 6 years where he served as Totco sales representative. Williams will leave shortly on an extended trip throughout all oil producing areas in South America, Central America, and Mexico. He will represent both Totco and the Lucey Export Corporation, handling Lucey's full line of equipment.

E. E. Williams

C. C. Williams

E. E. Trittschuh

Clyde C. Williams has been promoted to general manager of the marine and industrial engine division of Chrysler Corporation. **E. E. Trittschuh** was made manager of the marine engine division, the post left vacant by advancement of Williams. Williams, who had been marine engine division manager since April of 1946, joined Chrysler in 1928. A native of southern Indiana, his association with Chrysler has included duties as a service representative in Canada. Extensive experience in corporate finance lies behind Trittschuh, who served the General Electric Company at Schenectady, New York, Caracas, Venezuela, and Barranquilla, Colombia, and the accounting firm of Ernst and Ernst, New York, New York, before becoming associated with Chrysler.

Francis W. Cross has been appointed sales engineer, heavy machinery division, Nordberg Manufacturing Company, Milwaukee, Wisconsin. After graduating as an electrical engineer from Marquette University in 1936, Cross joined the Falk Corporation and worked in the shop and engineering departments until 1939 when he was transferred to the sales department. In 1941 he was appointed United States Navy Department Coordinator of plant facilities. In 1944 he returned to the Falk Corporation as assistant production manager.

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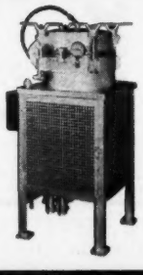

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▸ **L. A. Watts** has been appointed assistant general sales manager of the Wickwire Spencer Steel division of The Colorado Fuel and Iron Corporation. He is a graduate of Northwestern University. In 1938, Watts joined the then Wickwire Spencer Steel Company as a chemist in the Buffalo plant. Since that date, he has held numerous positions, among them being foreman, assistant superintendent and metallurgist in the Buffalo wire mill. In 1947, he was appointed manager of the general wire sales department. Watts is being succeeded by **R. M. Wagner** but will continue to supervise and direct the pig iron and semi-finished sales department.

L. A. Watts

In 1931, Wagner joined Wickwire Spencer Steel. Except for 4 years of service in the Armed Forces, his employment in the Corporation has been continuous. His most recent position was assistant wire sales manager.

▸ **William B. Goldey,** the European manager for the Lucey Export Corporation died in London, England on November 27, after a short illness. Goldey had a great many friends in the oil business especially throughout the foreign fields and had been connected with Lucey Manufacturing and Lucey Export since 1913.

▸ **Alan Good,** board chairman of Associated British Oil Engines, Ltd., was a visitor in Houston recently to confer with Cameron Iron Works officials. British Oilfield Equipment Company, a subsidiary company of associated British Oil Engines, Ltd., has recently been licensed by Cameron Iron Works to manufacture and sell Cameron oilfield equipment in the sterling area.

▸ **Marvin L. "Jack" Cunningham** has been named to the sales organization of Thermoid Company. As district manager in charge of oil field friction materials he will be responsible for sales in the Mid-Continent and California and will have his headquarters in Tulsa, Oklahoma. Cunningham is well known throughout the oil fields having begun his career as a roughneck and cementer.

M. L. Cunningham

▸ **Ray Staples** has become a partner in the firm of Cable and Stine, petroleum engineers, Wichita Falls, Texas. Staples, who has been associated with the firm since 1944, was formerly employed as a petroleum engineer in charge of production of a waterflood project in Southeastern Kansas, and later as a petroleum engineer with the U. S. Department of the Interior in Oklahoma. At Cable and Stine he is in charge of the Core Analysis Laboratory, salt water disposal, and water flood surveys and installations. The company has been in Mid-Continent fields for some time.

Ray Staples

▸ **Bertram V. Jones,** has been appointed advertising manager of Link-Belt Company, Chicago, Illinois, to succeed **Julius S. Holl,** deceased. **John F. Kelly** will continue as assistant advertising manager. Jones joined Link-Belt advertising department in 1923, and for 7 years served as advertising manager for Link-Belt Speeder Corporation, a subsidiary company. He became executive assistant advertising manager in July.

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Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
Houston—Henry H. Parts Distributor, Inc., Box 932
Kansas City, Mo.—Wm. J. Hebenstreit, 3122 Coleman Rd.
Los Angeles—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis—Lin J. Krause, 200 Lumber Exchange
Newark, N.J.—Murray Eskin, Industrial Office Bldg.
New York—Henry Stein, 50 Cliff St.
Philadelphia—J. W. Worthington, 401 N. Broad St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
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ELM GROVE STATION WHEELING, W. VA.

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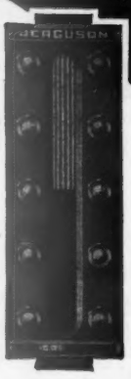

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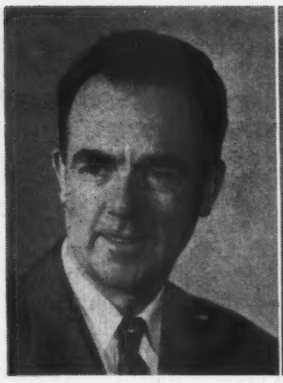

H. E. Maloney

F. T. Craven

R. H. Hainsworth

▸ **Howard E. Maloney** has been made manager of sales, John A. Roebling's Sons Company, Trenton, New Jersey. He has been associated with the Roebling Company for the past 9 years, beginning as a salesman in the Seattle district office. In 1949 he became assistant manager, the position he held until his recent appointment. **Frank T. Craven,** a member of the electrical staff since 1936, was appointed assistant manager of sales. He was first employed as a salesman in the Philadelphia district office. **Roy H. Hainsworth** became Eastern regional manager, with headquarters in Trenton. He joined the Roebling sales force in 1947, and has served in both the Denver and Chicago districts.

▸ **Charles Oxford** of the Ventura coastal area, Oil Base, Inc., has been named for sales and service of Black Magic oil base drilling fluid, White Magic oil emulsion mud, chemicals, and weight materials manufactured by Oil Base. Oxford served with Tidewater Associated in California for 2 years before joining the Armed Forces in 1941. After his discharge he was with Baroid for 7 years in California. He is an alumnus of the University of California.

Charles Oxford

▸ **H. J. Henke** has been named superintendent of the East St. Louis, Illinois, Bitumastic protective coatings plant of Koppers, Company, Inc. Henke formerly was superintendent of the Verona, Pennsylvania, plant of the Tar Products Division. A native of Honesdale, Pennsylvania, Henke attended Lehigh University before joining the Allis-Chalmers Manufacturing Company in Milwaukee, Wisconsin, as a test engineer in 1927. In 1929 he became associated with Koppers procurement department.

▸ **J. Paul Ekburg, Jr.,** of St. Louis, Missouri has been appointed to fill the newly-created post of assistant manager of petroleum chemicals sales, for Monsanto Chemical Company's organic chemicals division. In his new assignment, he will assist **J. W. Newcombe,** manager of the department since 1944, in handling the sales of Monsanto's broad range of lube oil additives. Ekberg has been with Monsanto since 1940 when he was graduated from Yale University with a B.E. degree in chemical engineering.

▸ **Frank E. Hutton,** Babcock and Wilcox Company, New York, was recently appointed to the position of executive assistant, in charge of the application and sales of heat and chemical recovery equipment, digesters, alloy castings, and other process equipment for the pulp and paper industry. Hutton, a graduate of Washington University, St. Louis, joined B&W in 1927 as an apprentice engineer.

▸ **Irving M. Dumm,** secretary-treasurer of Pacific Valves, Inc., Long Beach, California, has been named representative to the National Production Agency. He will represent the western states on the 20-man advisory council to the valve and fitting section of NPA. Dumm recently returned from Washington, D. C., where he participated in preliminary planning for operation of the industry under a defense economy.

▸ **Harvey L. Hurley** has been appointed assistant sales manager, of W-K-M Company, Houston, Texas. Hurley has been closely associated with the oil industry for many years, more recently with the Rockwell Manufacturing Company, and had his headquarters at Houston.

H. L. Hurley

▸ **F. L. Yetter** has been named senior vice president of C. H. Wheeler Manufacturing Company. Yetter rejoins the company after a 20-month period during which he served as director of foreign affairs for the Kuljian Corporation. He has long been associated with the power plant field, having begun with the DeLaval Pump Company in 1913, changing to the Alberger Pump and Condenser Company in 1915, and beginning his long tenure of service with Wheeler in 1916. In 1946 he was elected vice president and assistant general manager, from which post he resigned in 1949.

F. L. Yetter

▸ **G. A. Daeuble, Jr.,** vice-president of Henry Vogt Machinery Company and manager of valve and fitting sales, died unexpectedly at his home in Louisville, Kentucky, November 26. For many years he served on committees of the American Petroleum Institute.

▸ **Dean De Graffenreid** has been appointed district sales engineer for the Tulsa, Oklahoma, office of Byron Jackson Company. De Graffenreid joined Byron Jackson in 1947, as test engineer for the pump division. In 1948, he transferred to the sales department of the pump division and was assigned to the Los Angeles Branch Office, his work being primarily in the oil industry of Southern California. In May of this year he was assigned to the division office in Tulsa.

D. De Graffenreid

▸ **N. W. Landis** has been named manager of Allis-Chalmers' Detroit district office succeeding **F. S. Schuyler,** who is retiring after 43 years of service. Landis had been manager of the company's Syracuse office since 1946. He has been connected with Allis-Chalmers since 1938. **A. J. Mestier, Jr.,** a sales representative in Allis-Chalmers' New York district office since 1948, succeeds Landis as manager at Syracuse. He joined Allis-Chalmers in 1946. Schuyler has been associated with Allis-Chalmers since 1907. He became manager of the Detroit office in 1920.

▸ **Edward J. Hanley** has been elected as president and **Clark W. King** as executive vice president of Allegheny Ludlum Steel Corporation. Hanley, presently serving as executive vice president, will succeed **E. B. Cleborne,** who resigned. King, who is now vice president and treasurer, succeeds Hanley and will retain the position of treasurer. Cleborne will continue to serve the company as a director and vice president.

Frank B. Lounsberry has retired as vice president and technical director and **W. B. Pierce** has been named technical director. He is former manager of sales development.

▸ **Clyde P. Whitmire** has been appointed special factory representative to the oil industry by Hobart Brothers Company, Troy, Ohio, manufacturers of arc welding equipment. Whitmire served with A. O. Smith Corporation for 5 years as a field welding engineer. Prior to that he was with Bechtel-Price-Callahan and White Horse Refinery in Canada. He will be at 1812 North Boston Place, Tulsa.

C. P. Whitmire

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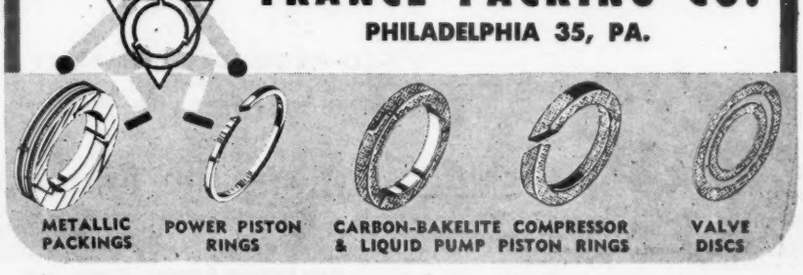

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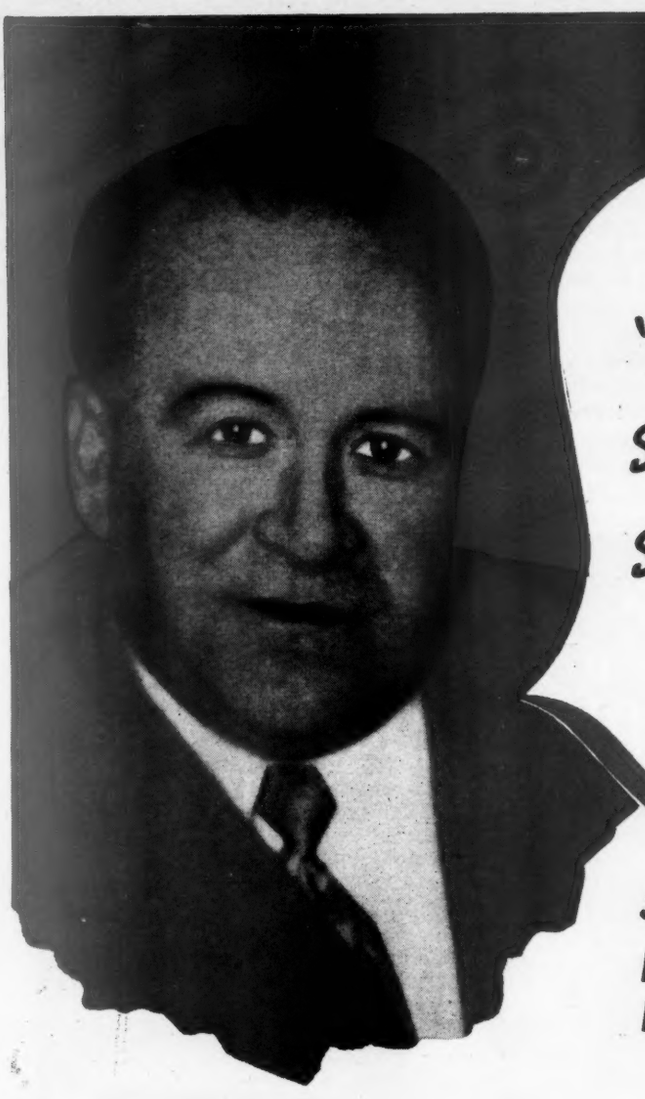

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THERE was a time when Ryan and Sharp used tank bottoms for road oiling. That was before they switched to Visco. Now, with no tank bottoms, they buy road oil — and still profit substantially on added barrels of Visco-treated pipeline oil!

This example of Visco efficiency can be the key to lowest cost per barrel of dry oil on *your* leases . . . Call Houston, CAPITOL 7300, collect, for full data on real emulsion-breaker economy.

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Visco.... **CONSISTENTLY EFFICIENT DEHYDRATING AND DESALTING CHEMICALS**

NOTICE: Visco Products Company is authorized to manufacture and sell Visco Oil Treating Compounds for use in the breaking and resolving of oil emulsions, or to grant licenses for such use, under the following United States Letters Patent: 2,050,639; 2,050,640; 2,206,589; 2,214,783; 2,214,784; 2,225,189; 2,303,414; 2,307,813; 2,318,034; 2,318,035; 2,321,056; 2,335,554; 2,454,808; 2,514,399. Visco Products Company is willing to grant licenses on a royalty basis, to oil companies, and to others desiring to practice the patented subject matter, under any and all of the above Letters Patent, permitting the user to purchase the oil treating compounds at will from any vendor, or to prepare the compounds for use or to use the compounds under the above Letters Patent. Application for license should be made to: **Visco Products Company,** Houston, Texas.

Machinery and Equipment

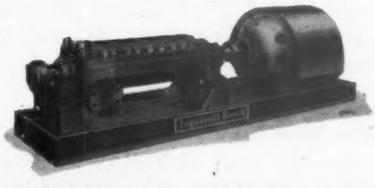
New! Improved! Needed!

(1) Induction Motor

Fairbanks, Morse and Company, Chicago, Illinois manufacturers, have recently extended their line of type QZE, totally enclosed, non-ventilated, squirrel cage, induction motors to include continuous duty ratings built in NEMA standard frame 284. At present, 7½ hp, 1800 rpm and 5 hp, 1200 rpm motors are in production. These motors conform in all respects to NEMA and ASA standards for totally enclosed machines, and are identical in mounting dimensions with standard totally enclosed, fan-cooled motors of the same ratings. They are admirably suited for service in adverse locations where dirt, dust, lint, metal turnings, and sand are prevalent, since there are no ventilating openings to clog.

(2) Centrifugal Pumps

Ingersoll-Rand Company, Phillipsburg, New Jersey, has announced a line of completely new multi-stage centrifugal pumps for high-pressure



applications to 1200 psi and capacities to 1600 gpm. Known as the Class HMTA, they are built in 3, 4, 5, and 6-in. sizes with from 3 to 9 stages. Features of this new design are its cylindrical - bore, horizontally - split casing and compact, unit-type rotor assembly.

(3) Synchronous Motors

The General Electric Company has announced that it has extended its line of Tri-Clad high-speed synchronous generators down through 1.875 kva. This now makes available a complete line of generators in Tri-Clad construction from 1.875 to 1250 kva. The new machines which have been added to the line are available in four basic designs, which have ratings from 1.875 to 50 kva. Designated as Types ATI, ASI, and ATB, the generators have frequency ratings of 60 and 400 cycles. Three standard types of 60 cycle generators are offered.

(4) Filling Meter

Production of a new 60 gpm 1½-in. pipe size barrel filling meter is announced by A. O. Smith Corporation, Los Angeles 22, California. The new meter measures repeat quantities from 25 to 79 gal by one gallon increments. Only a single gear change is necessary to obtain different quantity settings. Changes in settings may be made without use of any tools.

(5) Treaters

Black, Sivalls and Bryson, Inc., Kansas City, Missouri announces the placing on the market of its all-purpose, field-tested type "J" treater. This new treater consists of a large vertical shell that is divided into three sections. In the separate or top section "Cold" separation of gas and oil takes place. In the bottom section is included a large capacity firebox that serves as a heater and water knock-out. The settling or middle section of the treater is a large capacity quiet zone for the final separation of oil and water. The three sections are independent of each other being separated by heavy diaphragm plates. Each section may be inspected separately.

(6) Rod Clamp

Altens Foundry and Machine Works, Inc., Lancaster, Ohio announces that the firm is now in production on a new polished rod clamp, the Wonbolt, Sr. Similar but larger than the Wonbolt, Jr. which Alten introduced last year, this new clamp has only one nut to secure and is completely self aligning. It is made from high tensile, heat treated malleable iron with a high tensile steel nut and bolt SAE threaded. Although the Wonbolt, Sr. weighs only 12 lb it will support a 36,000 lb load. Tests have indicated that a 140 lb man can fully secure this clamp in less than 30 seconds using a single 24-in. wrench.

These are very brief descriptions of new items manufacturers have put on the market but you need more information to appreciate advance in design, materials, performance, etc. Send the coupon below for details.

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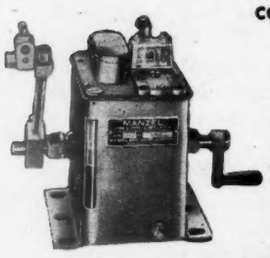
Force Feed Lubricators

Many Manufacturers serving the petroleum industry standardize on Manzel Force Feed Lubricators. Manzels supply all wearing parts with just enough lubricating oil . . . cut labor costs . . . reduce oil consumption . . . prevent costly breakdowns.



Model 25

Double Plunger Type. One to thirty feeds. Each feed adjustable, from fraction of a drop to .13 drops per stroke.

Model 94

Liquid Sight Feed Type. Suitable for pressures up to 3,000 lbs. Handles oil of any viscosity, delivering it at regular intervals.

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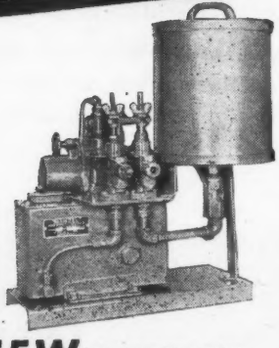
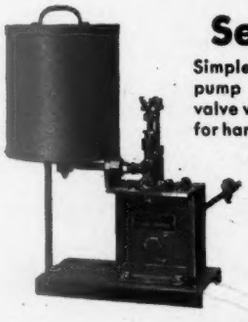
Sturdily built and simply designed, Manzel feeders have an unsurpassed record for dependable, trouble-free operation.





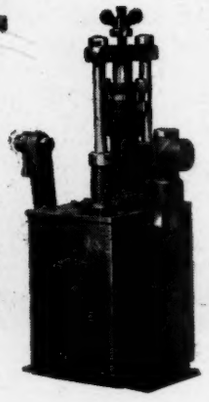
Series 60T

Simple, sturdy, single plunger pump with patented piston valve which is highly efficient for handling heavy chemicals.

***NEW* CORROSION RESISTANT MODEL 47TX**

A cone valve type feeder for handling heavy or light chemicals. Reciprocating or rotary gas drive motor is automatically self-lubricated to resist corrosion.

Be sure to specify Manzel on your next installation . . . and write for helpful information about obtaining Manzels for your present equipment.



Series 80T

Built on the same principle as the series "60" but larger and heavier. Handles chemicals in much greater quantities.

Manzel

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BUFFALO 10, N. Y.

(7) Plastic Models

Ideal Models Company, Detroit, Michigan has developed a new device for demonstrating the operation of the torque converter for Detroit Diesel Engine Division of General Motors Corporation. The device is constructed entirely of transparent and colored plastics and is a model of the torque

converter used with General Motors Series 71 and Model 6-110 diesel engines. The model is held securely to a table or show case by rubber suction cups and is activated by a small crank. The crank sets the "pump" section of the converter in action and the resulting flow of fluid that causes the transfer of power from the "pump" to the "turbine" is easily discernible.

(8) Shackles

A new type of shackle that provides new factors of safety and of speed is being produced by the George E. Failing Supply Company of Enid, Oklahoma, manufacturers and suppliers of portable drilling equipment. This new shackle can be positively opened or closed even in the dark. Cotter pins have been eliminated in this new shackle. The shackle comes in various sizes.

(9) Drilling Fluid

Ken-oil, an oil base drilling mud developed by Union Oil Company of California and heretofore available only in California, is now available in the Mid-Continent, West Texas and Rocky Mountain areas through Mud Control Laboratories, Inc., distributor. Ken-oil liquid concentrate, manufactured by Ken Corporation, when mixed with 9 parts of low cost fuel oil or low-gravity asphaltic crude oil will produce an oil base mud having all the desired characteristics of a stable drilling and completion fluid.

(10) Dry Chemicals

A dry chemical piped system, designed for automatic protection of industrial fire hazards, has been developed by Ansul Chemical Company, Marinette, Wisconsin. This new fire protection system, the first using dry chemical as extinguishing agent, is operated by an heat-actuated device.

(11) Centralizers

B and W Inc., Houston, Texas has developed a new centralizer with a new "Kon-Kave Bow." The new centralizer spring employs the principle of the arch in its curved cross section, and has double the strength of the usual flat spring. This increased strength provides positive centering of the casing, and insures a uniform

collar of cement entirely around it. The "Kon-Kave Bow" is drop forged from alloy spring steel and the usual heat treatment is supplemented by additional treatment to relieve all internal stresses created in forming the bows and welding them to the hinged collars. This treatment produces a stable spring that will withstand the flexing stresses as casing is run and still retain their original outer diameter, according to the manufacturer.

(12) Drilling Method

The George E. Failing Supply Company, Enid, Oklahoma has announced a new method of exploration drilling with its 1500 Holemaster drill. Designed for drilling in areas where boulders or loose unconsolidated materials predominate, the new drill features a special arrangement whereby the Kelly is eliminated and drilling is accomplished by connecting the swivel directly to the casing. This new method currently is being used by the Sun Oil Company in this country and by the Canadian Superior Oil Company of California in Canada, the company states. Inside diameter of the drive rod is increased to 4¼-in. This arrangement provides for the use of 3-in. line pipe casing and clearance for the couplings.

Petrol Can Making Plant
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Automatic 4 gal. tinplate petrol can manufacturing plant by Bliss. Capacity 10,000 cans per 8-hour shift. This is a NEW PLANT and has never been used.
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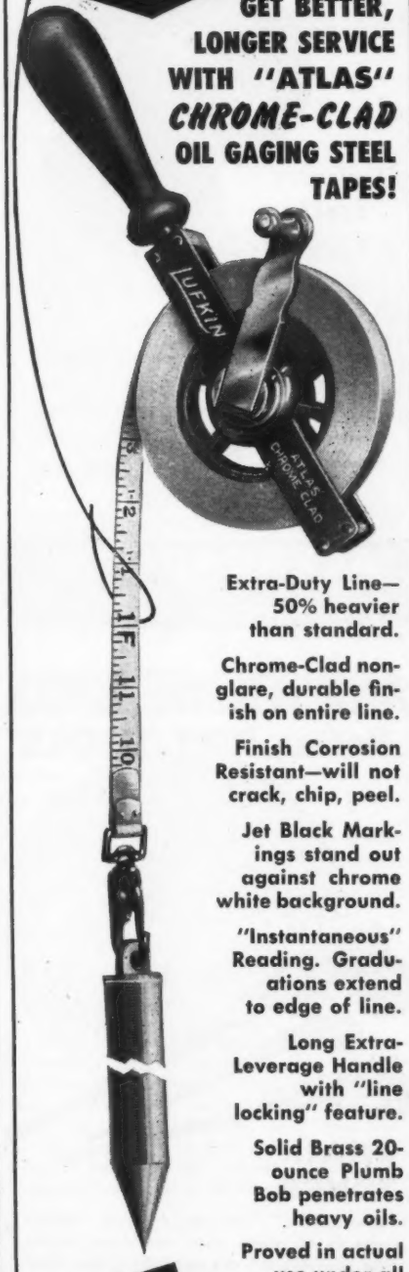

Extra-Duty Line—50% heavier than standard.
Chrome-Clad nonglare, durable finish on entire line.
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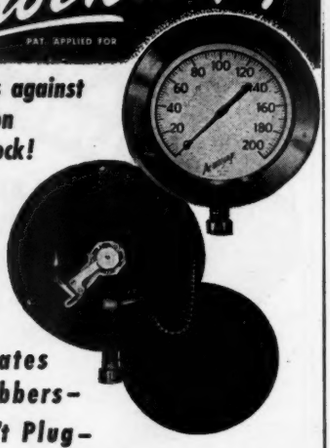

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Better PIPE TOOLS

CHAIN TONGS

"Reversible," "Standard" and "Ideal" types in all sizes. Jaws are drop forged from special steel, are carefully milled, heat treated hardened and tested. The *Handles* are forged spring steel. The *Chains* are proof-tested to ⅔ catalog strength (1,200 lb. to 40,000 lb.). "Reversible" Jaws give double jaw life. "Standard" Jaws have extra bearing on the handle and forged-in chain guides. The "Ideal" Tongs have V shaped teeth for a sure grip on irregular shapes—fittings, etc.

Write for Catalog

ARMSTRONG BROS. TOOL CO.
"The Tool Holder People"
5231 W. ARMSTRONG AVENUE • CHICAGO 30, ILL.

(13) Two-Cylinder Engines

Nordberg Manufacturing Company, Milwaukee, Wisconsin, announces the addition of a 2-cylinder engine to supplement the Type 4FS1 single cylinder, 10 to 15 hp diesel engine which has won ready acceptance in the small power field. This new engine, rated at from 20 to 30 hp within an operating speed range of 1200 to 1800 rpm, has a 4½-in. bore and 5¼-in. stroke and is an extra heavy duty, vertical, four-cycle, mechanical injection diesel engine.

(14) Petroleum Storage

Graver Tank and Manufacturing Company, Inc., East Chicago, Indiana, has recently introduced its design for a center-weighted floating roof. This new design was developed to combine the vapor-saving and corrosion-resistant features of the double-deck floating roof with the more economical aspects of the conventional pan-type floating roof. The roof itself is a low-angle, inverted flexible cone which, floating on top of the petroleum product in the tank, gains stability by the weighted pressure of the cone in the liquid.

(15) Cooling System Filter

A cooling system filter, developed by Spark-O-Liner Corporation, Minneapolis, Minnesota, is claimed to prevent much of the engine breakdown expense and lost time due to over-heating in liquid-cooled gasoline or diesel internal combustion engines. The new electro-chemically activated cooling system filter has been used in the trucking field during the last several years, and has recently been put to use in the passenger car field with a smaller unit known as the "Model P."

(16) Rod-Wear Detector

Tuboscope Company of Houston, Texas announces the development of an electrical rod-wear detector for tubing. The instrument weighs only 20 lb and can be operated by one man. It is designed for rod-wear inspection of tubing on the rack. This instrument is offered on a service or rental basis in the Mid-Continent and Gulf Coast areas.

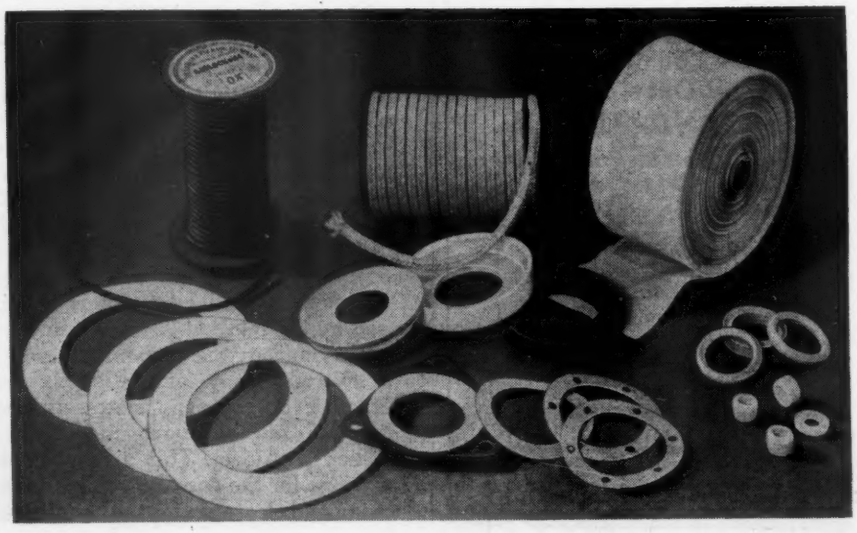
(17) Generator Units

WA-Series steam turbine-generator units, a modern line presently developed in 500 to 7500-kw ratings, has been announced by Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. These units are high speed, compact, streamlined units. Being steam turbine driven units, they can operate with economical regenerative feedwater heating cycles and can also be tied-in thermodynamically to provide a steam-power balance where low pressure process steam is utilized.

(18) Packings and Gaskets

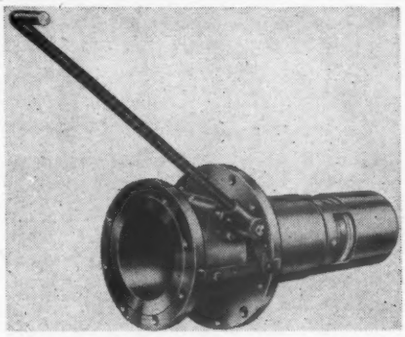
The Garlock Packing Company, Palmyra, New York, announces its packings and gasketing materials made of "Teflon" are fabricated in the Garlock factories from a tetrafluoroethylene resin developed by E. I. duPont de Nemours and Company and marketed by that company under the trade name of "Teflon." They are extremely inert to chemicals, and heat resistant. These Garlock packings and gaskets made of "Teflon" are unaffected by any acid and are highly resistant to all organic solvents and alkalies. They operate at temperatures from below —90 F up to 500 F and have high mechanical strength and a low coefficient of friction within that temperature range.

Packing and gasketing materials made of "Teflon."



(19) Internal Valve

A new spring loaded internal safety valve for petroleum storage and transfer tanks has been announced by Shand and Jurs Company, Berkeley, California. Designated Fig. ST-6810,



this cast steel S&J internal safety valve has been designed primarily as a safeguard for personnel, stored product, and storage equipment should fire occur near a tank. The spring loaded S&J valve is opened by a manually operated lever. This lever can be locked in the open position by a cable and fusible link.

(20) Flow Transmitter

Fisher and Porter Company, Hatboro, Pennsylvania announces its new V/A cell, precision flow transmitter developed for differential pressure applications. Being basically a through-flow instrument of the variable-area type it measures a bypassed portion of the main-line flow. Continuous self-purging is thus provided. It features high accuracy with wide-range, linear scale. It is mercuryless but does not utilize a diaphragm of any kind.

(21) Universal Joints

The Curtis Universal Joint Company, Inc., Springfield, Massachusetts, announces the development and availability of a new Lo Friction universal joint, available in single or double joint form, 1¼-in. OD or larger, solid or bored hubs, round, keyed or splined shafts. This Lo Friction joint is an addition to the line of Curtis standard joints.

(22) Steel Tape

The Lufkin Rule Company of Saginaw, Michigan has improved its "Leader" chrome-clad steel tape. It is now available with a maroon-colored Vinylite covered case. The Vinylite case resists water, will not stain or scuff. It has a roller type throat and a flat stainless steel edge band that is flush inset and attractive name plate. The nickel plated winding mechanism has folding flush handle opened by push pin.

The Pipefitter's Best Friend

HANDLE-BAR

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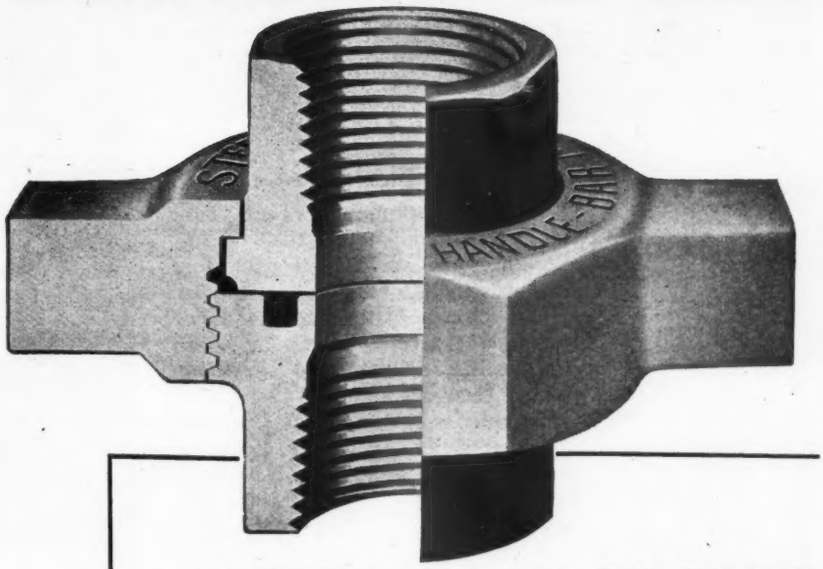
Forged Steel Unions



HANDLE-BAR "O" RING

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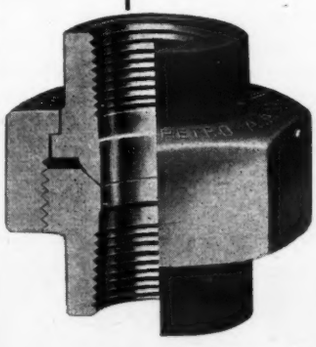
Unions are designed and precision made to assure ease of tightening, a long life, and real economy. A synthetic oil-resistant "O" Ring is set between the two mating surfaces which when hand tightened affords a positive pressure seal. "O" Ring is recommended for cementing, mud, crude oil, lube oil, natural gas, and water services and will work satisfactorily on acidizing, fuel oils, kerosene and gasoline. Pressures 500-3000 lbs. Temperatures to 212 F. Special Silicone "O" Rings available for temperatures to 500 F.



PETRO A.A.R.

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design unions conform to the inside dimensional specifications of Association of American Railroads standards. In standardizing on A.A.R. you have the assurance of interchangeability at all times. PETRO A.A.R. Unions will interchange part for part with any A.A.R. union malleable or forged steel. PETRO'S basic design and its many other features make it a most useful union.

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

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ORIGINATORS AND PIONEERS OF STEEL UNIONS SINCE 1912

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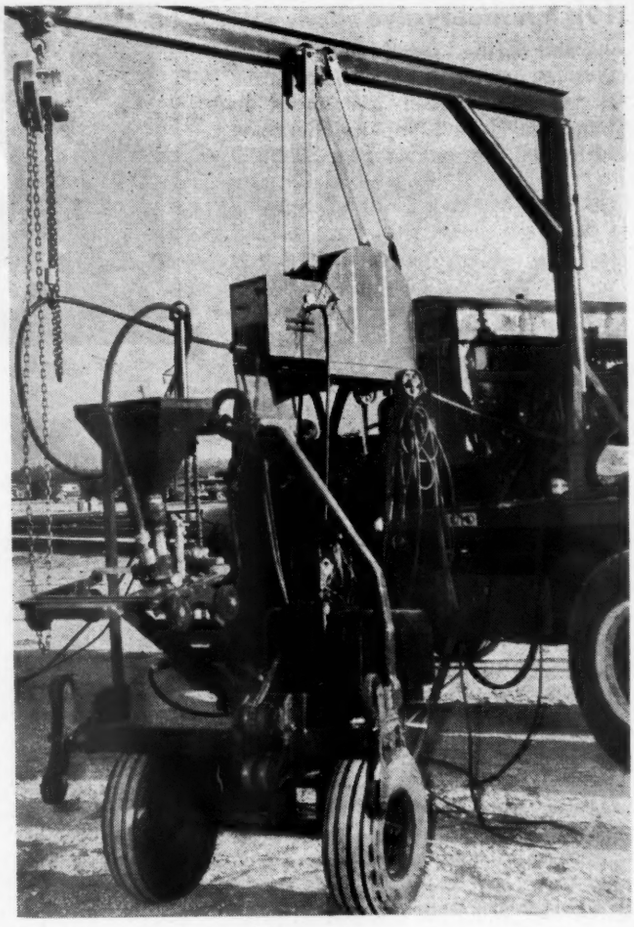
1900 DEMPSTER STREET • EVANSTON, ILLINOIS

(23) Welding Unit

Hauser Pipe Line Equipment, Inc., Fort Worth, Texas, an affiliated company in O. R. Smith Contracting Corp., has developed a new portable pipe line welding unit, to be used in solving the problem of double-jointing and sectioning all sizes of pipe from 4-in. to 36-in. The unit consists of a pipe rolling rig mounted on pneumatic tires. An electric motor and a speed reducer, provide the driving power through a chain that encircles the pipe. The pipe is supported on dollies designed to reduce rolling friction to a minimum and to prevent spiral motion as the pipe is rotated. A self adjusting arm, which is an integral part of the main frame, allows the welding carriage to ride on the outside surface of the pipe. A frame within the carriage, which has lateral adjustment, provides a mounting for the welding gun and the flux box.



Portable pipe line welding unit.

Shorty Block

(24) Shorty Blocks

The International Derrick and Equipment Company, Dallas, Texas announces the addition of a 200 ton capacity block to their regular line of shorty blocks. These blocks have found wide acceptance among operators using drilling and servicing masts. They are unitized assemblies that combine the block, spring loaded link adapter and swivel bail hook into a short compact assembly. Added head room provided by this design permits faster operation as the pipe may be hoisted safely at full speed to the top of the run.

(25) Automatic Titrator

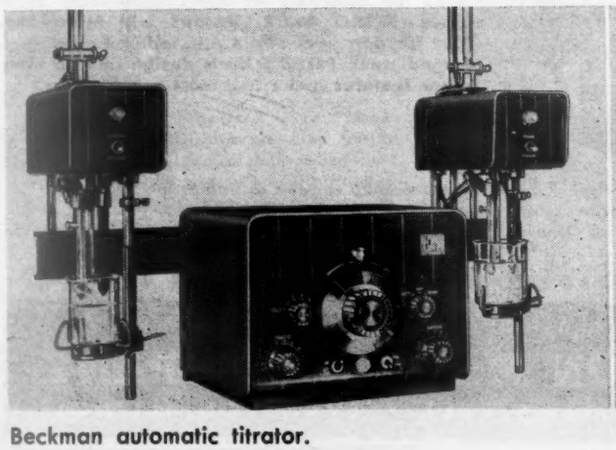
Beckman Instruments, South Pasadena, California, recently announced the Beckman automatic titrator. As its name implies, this new instrument handles routine titrations completely automatically. It makes accurate titrations more rapidly and conveniently than is possible by manual methods, and also gives objective, reproducible results that are free of errors due to personal factors. Further, it eliminates the eye-strain and fatigue caused by the close observation necessary in manual procedures. Operation is unusually simple and convenient.

(26) Process Pumps

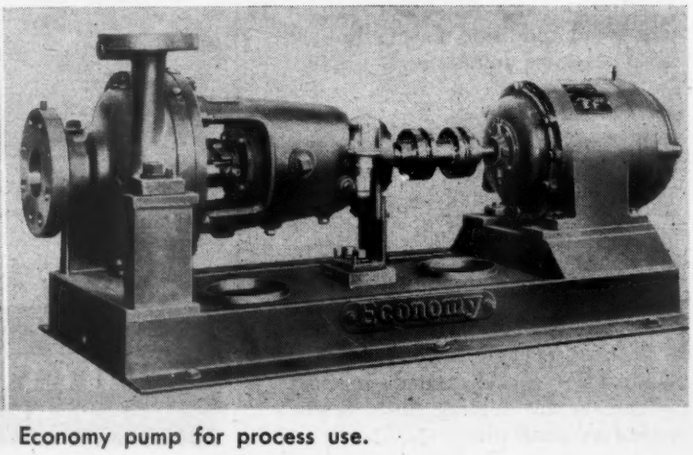
An improved line of pumps for process use has just been announced by Economy Pumps, Inc., division of Hamilton-Thomas Corporation, Hamilton, Ohio. Known as "Type Q" pumps, the new line is especially designed for use with Dowtherm hot oil, condensate, propane, butane, gasoline, chemical, and process liquors at temperatures up to 800 F. Although materials used in their construction varies for each particular application, "Type Q" pumps have common design features said to contribute greatly to performance.

(27) Heating Units

New serpentine flexible electric units which can be applied to pipes, valves, cylinders and containers carrying viscous or free-flowing fluids, chemicals, plastic compounds or gases have been announced by the Titan Manufacturing Company, Inc., Buffalo 2, New York. Sheathed in $\frac{5}{16}$-in. diameter spring steel, the units combine flexibility and strength with minimum bending radius of $\frac{1}{2}$-in. Due to refractory insulation, they can operate at temperatures approaching 1000 F for long periods. Standard units are 1 ft to 10 ft.



Beckman automatic titrator.



Economy pump for process use.

(28) Wrenches

A new design in wrenches in all sizes of combination and open-end is now being marketed by Bonney Forge and Tool Works, Allentown, Pennsylvania, makers of mechanics' hand tools. The new line is streamlined, slim, light in weight, and well balanced. The latest line of Bonney wrenches is made in long and short series with the box wrench ends in either single or double hex.

(29) Hand Valves

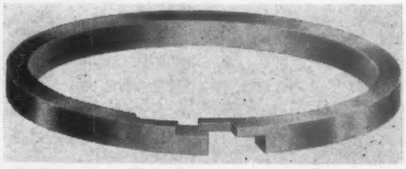
A line of valves for actuating air or hydraulic cylinders has just been introduced by Ledeen Manufacturing Company, Los Angeles, California. The firm also builds a line of actuating cylinders for air, oil, water or steam operation. The Ledeen valves embody the rotating disc construction and are made in three types: For hand-operation, foot-operation, and finger or solenoid operation. This group of valves is available in 14 different models for 5 different cycles in 6 sizes.

(30) Power Drives

New improved mechanical remote control for Sterling Speed-Trol (variable speed) electric power drives has just been announced by Sterling Electric Motors, Inc., Los Angeles 22, California. This control is designed so that it can also be adapted to any Speed-Trol, now in use. This remote control is available in a variety of types, such as with extended flexible cable, as illustrated, or with an extended rod with universal joint, right angle bevel gear with extended rod, chain and sprocket, or a combination of any or all of the above.

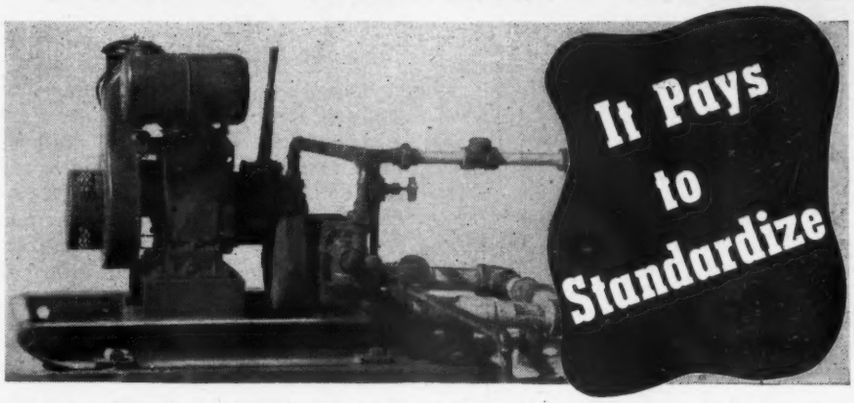
(31) Piston Ring

A new ring has been developed by the Double Seal Ring Company of Fort Worth, Texas. The new ring, the Sealock, has been field tested for more than a year and a half. The one-piece Sealock incorporates a feature that locks one of the ring ends "in" tightly against the other. The locked end thus is prevented from expanding into ports in a cylinder wall.



Greatly reduced ring breakage is listed as the outstanding result achieved, according to field-test users of Sealock rings in two-cycle engines. They also report that there is much less wear of cylinder walls and ring.

PUMPS or WISCONSIN ENGINES



This husky Wisconsin-powered pumping unit, built by Harley Sales Co., is used to pump salt water, crude oil, distillate, gasoline, and many chemicals. It discharges at rates up to 3000 lbs., pumps up to five barrels an hour, and similar models can be built of various types of metals.

When it comes to power, many users are STANDARDIZING on Wisconsin Heavy-Duty Air-Cooled Engines. Being extremely compact, these engines mount easily on almost every type of machine. Overall weight is reduced, fewer costly gears are needed. Dependable air-cooling eliminates all climatic trouble-hazards. Rotary-type outside magneto with impulse coupling assures quick, easy, any-weather starting, at lower cranking speed, plus dependable operating ignition.

Wisconsin Air-Cooled Engines are supplied in 4-cycle, single-cylinder, 2-cylinder, and V-type 4-cylinder models, 3 to 30 hp.

WISCONSIN MOTOR Corporation
MILWAUKEE 46, WISCONSIN
World's Largest Builders of Heavy-Duty Air-Cooled Engines

WRITE TO HARLEY SALES CO.
510 ATLAS BUILDING, TULSA, OKLAHOMA
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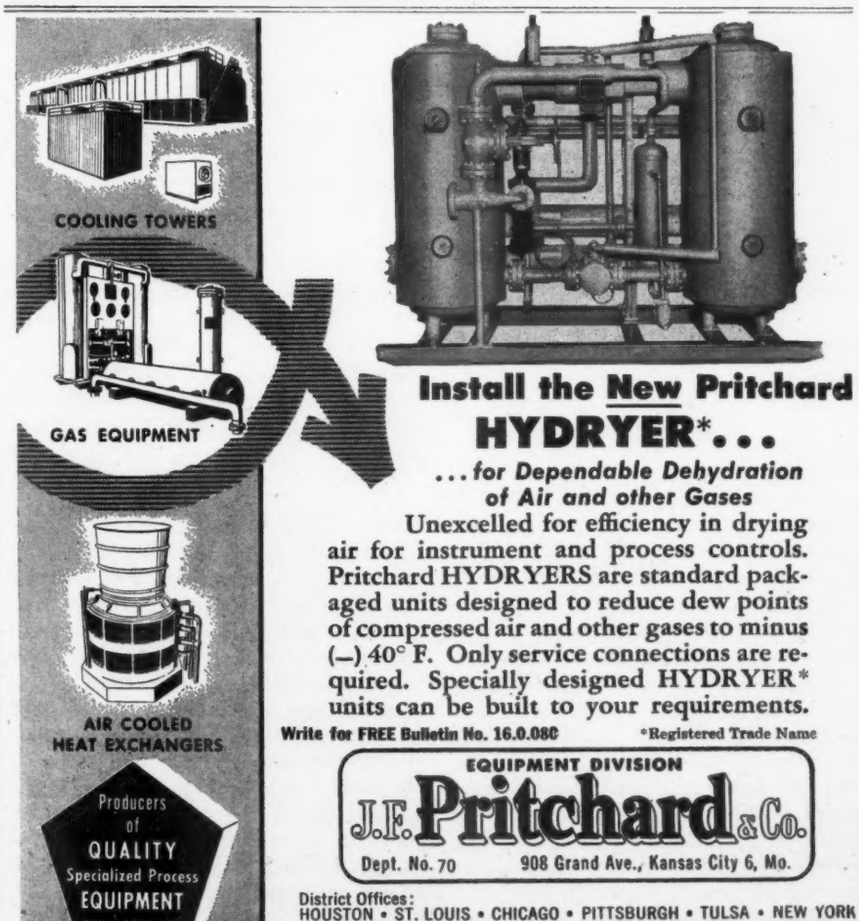
OIL FIELD DISTRIBUTORS FOR WISCONSIN ENGINES AND ALL TYPES OF UTILITY UNITS.



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...for Dependable Dehydration of Air and other Gases

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(32) Power Shovels

A new bulletin just published by the Thew Shovel Company, Lorain, Ohio, features the application of Lorain power shovels and cranes to pipe line construction. Special attention is given to the Lorain "Pipeliner" a specially designed hoe with wide gage crawlers to straddle pipe line ditches. Application of other types of Lorain equipment such as clamshells, draglines, and cranes is also depicted. The story of the use of rubber-tire Lorain moto-cranes for pipelining and how they can roll long distances quickly to widely separated spreads is also included.

(33) X-Ray Photometer

A new 8-page, 2-color bulletin on the x-ray photometer for chemical analyses by x-ray absorption has been announced as available from the General Electric Company, Schenectady 5, New York. Designated as publication GEC-412A, it lists some of the applications for the instrument in the petroleum and chemical industries. Profusely illustrated, the bulletin explains the theory of operation, principal components, and operating procedure of the G. E. x-ray photometer. Also included in the bulletin are complete specifications of the new measurement aid along with procedure information for obtaining analyses on the x-ray photometer by submitting samples to G. E.'s laboratories.

(34) Verticle Pumps

Johnston Pump Company, Los Angeles 58, California has issued a new loose-leaf phamphlet of illustrations to show the many uses to which the Johnston vertical pump may be adapted. Emphasis in this phamphlet has been placed on pumps that will meet the problems found at food processing plants, paper mills, chemical plants, municipalities, airports (pumping fuel) and oil refineries. A great deal of attention is given to the Johnston volatile liquid pump, which is especially suited to pump oil, gasoline, kerosene, and other liquids that tend to vaporize when being pumped unless a pressure is placed on the suction bowl of the pump. These data are complete with illustrations.

(35) Stainless Steel

A new folder describing paper-thin stainless steel has been published by Armco Steel Corporation, Middletown, Ohio. "Paper-Thin Stainless for Light Vital Parts" shows where stainless steel, .010 to .001 in. thick, has been used and outlines its manufacturing advantages. Complete information is given on how the metal is supplied, along with typical mechanical properties. Of special importance is the description of Armco 17-7 PH thin-gage strip, which has a tensile strength comparable to the best high carbon spring steel.

(36) Standard Steel Lists

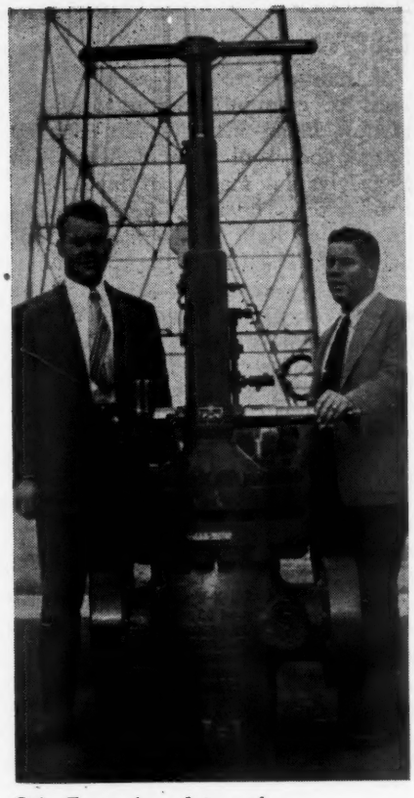
The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania, offers a revised edition of combined standard steel lists of AISI and SAE. The four-page technical data card covers three groups: Basic open-hearth and acid-bessemer carbon steels and resulphurized carbon steels, open hearth and electric-furnace alloy steels, and stainless and heat-resisting steels, subject to standard variations for check analysis. Percentage of chemical composition limits and other elements are stated for each steel. It is known as technical data card 119C.

(37) Data Card

A new data card on seamless and welded pipe of carbon, alloy, and stainless steels is offered by The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania. Table 1 lists dimensions in 16 sizes of pipe from ⅛-in. to 8-in. nominal size, with 5 different weight schedules according to wall inches and inside diameter. Table 2 gives ASTM and ASME specifications with grades and analyses for various types of pipe for high-temperature, etc.

(38) Steel Tubing

The Babcock and Wilcox Tube Company, Beaver Falls, Pennsylvania, offers a new bulletin, "Descriptive Terms—Steel Tubing." This 20-page, pocket-size booklet presents brief descriptions of terminology used in the manufacture and application of steel tubing. As the meaning of many of the terms used by the tubing industry is more specific than the ordinary definition of the term, the booklet will be of interest and value to anyone connected with the production of items using tubing.



Otis Type A safety valve.

(39) Safety Valves

A four-page, illustrated folder containing a technical article on its new, fully-automatic "Type A" surface safety valve has been published by Otis Pressure Control, Dallas, Texas. The new valve, available in a wide variety of types for various oil- and gas-line installations, combines the operating and engineering principles of Otis tubing safety valves and the "Type X" Otis surface safety valve. It is recommended for lines on offshore wells or in isolated locations where full-opening valves are not required. The Type A Safety Valve may be installed upstream of the surface choke and activated by high- or low-pressure fluctuations.

(40) Flow Meters, Relays

Moore Products Company of Philadelphia, Pennsylvania has issued 2 bulletins on 2 new instruments. Bulletin 11-1 shows a new flow meter that is especially suitable for applications involving high pressures. A remote-set Nullmatic controller is an integral part of these instruments—meeting the modern requirement for easy installation of the controller at the process on flow applications. Bulletin 681 covers a new line of relays that receive 1, 2, or 3 loading pressures and provide a wide selection of totalizing, amplifying, and other functions. They are used particularly in cascade control circuits.

(41) Alloys

Two new cobalt-base alloys are described in a completely revised edition of the booklet, "Haynes Alloys for High-Temperature Service," just published by Haynes Stellite Division, Union Carbide and Carbon Corporation, Kokomo, Indiana. The new booklet contains 96 pages of technical data on 10 alloys that were specially developed to meet the exacting demands of service at elevated operating temperatures. A section on each alloy gives a general description of the material, recommended uses, chemical composition, and physical and mechanical properties, in both tabular and graphic form. Nine pages of graphs compare the mechanical properties of the various Haynes alloys. Age-hardening data and fabrication procedures are also included. The two alloys added to Haynes line are known as Alloys Nos. 25 and 26.

(42) Chemicals

The new product development department of American Cyanamid Company, New York 20, New York, announces the publication of "Collective Volume II," a compilation of data on several new chemicals that have become available from the company's research laboratories during the last year, and on which separate bulletins have been issued. Some of the chemicals covered are: Beta-substituted propionitriles, 3-substituted propylamines, Dipropionitriles, 2-nitrodiphenylamine, 2-aminobenzenethiol, Antioxidant 2246, Sodium Dicyanamide.

(43) Packings

A new catalogue covering packings and piston rings for industrial service has just been released by the France Packing Company of Philadelphia, Pennsylvania. Format of the 40-page book is a comprehensive study of applications for all types of packings and piston rings. Special attention has been given to new developments in France's exclusive Carbon-Bakelite process and vital subjects such as chrome-plated piston rings and the new Teflon piston rings.

(44) Steel Pipe

Naylor Pipe Company, Chicago 19, Illinois has published a new bulletin concerning its lockseam spiralweld steel pipe, fittings, couplings, and accessories in complete detail. The major physical properties of Naylor Pipe, including the table on collapse pressure, are detailed on one page of this bulletin, which contains all the essential information needed for a quick reference.

(45) Plunger Relays

How relay maintenance can be eliminated is explained in detail in the new, fully-illustrated Catalog No. 17, describing H-B Mercury plunger relays, published by H-B Instrument Company, Philadelphia, Pennsylvania. In addition to complete specifications covering normally-open and normally-closed tubes and relays with various mountings, diagrams and cutaway illustrations show how these relays work.

(46) Generators

The inside story of the *why* and *how* of the E-M "Packaged" Generators (3.75 to 187 KVA) is given in a new 16 page, 2 color booklet, "The ABC of 'Packaged' Generators", published by Electric Machinery Manufacturing Company, Minneapolis, Minnesota. Much helpful electrical information, plus charts, graphs, and illustrations to aid in the selection and application of "Packaged" generators is included. Available types for various engine mountings and drives; tables showing types of electrical service provided, information on how to figure motor requirements; power factor tables; charts for figuring wire and conduit sizes, current and power requirements of motors and voltage dip for a given horsepower motor, are also found in this booklet.

(47) Chlorinizer

Builders-Providence, Inc., Providence, Rhode Island, has just issued a new bulletin (840-G27) on the new Model HCVS volumetric chlorinizer. This 4-page bulletin describes the high capacity visible flow chlorinizer, which is designed to meter chlorine gas accurately at rates from 100 to 6000 lb per 24 hours. The bulletin lists the many features of the chlorinizer and shows a cut-away drawing of the functioning parts. An easily readable diagram shows how the operation of the Chlorinizer is carried out. A discussion is included on safety features, low maintenance costs.

(48) Insert Pumps

Two 4-page, fully illustrated folders, each describing operating and other technical data on 3 newly designed insert pumps, have been published by Harbison-Fischer Manufacturing Company, Fort Worth, Texas. The firm has marketed a new "H-F 3-Tube" rod pump for lifting dirty, abrasive, sandy, and/or high-temperature fluids, and also recently introduced heavy-duty models of its "Tuff-Temper" and "Precision" pumps for deep-well production.

JOHNSTON VERTICAL PUMPS...

JOHNSTON TURBINE PUMPS

- *Save on Power Costs*
- *Minimize Maintenance Expense*
- *Conserve Space*

Johnston Vertical Turbine and Propeller Pumps embody *so many* advanced features—features that save power, minimize maintenance, conserve space, and increase over-all operating efficiencies that they are literally revolutionizing pump performance standards in industry after industry. They are staying on the job longer with less upkeep. They are delivering *more volume* against *higher heads* at greatly reduced power costs. They are cutting floor space requirements as much as 60% over that required for other-type pumps. *And they are making many other vital savings!!!*

These are facts backed by in-the-field reports from hundreds of Johnston installations in many industries . . . facts you should investigate before your next pump purchase. Johnston engineers will supply you gladly with complete information on the savings you can expect from a Johnston Pump on your specific fluid-moving job.

A letter, wire or phone call will get prompt attention and action.

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JOHNSTON LITTLE BEAVER PUMPS — For 4" Minimum Well Size

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JOHNSTON CLOSE COUPLED TURBINE PUMPS — For Industrial Applications

JOHNSTON DEEP WELL TURBINE PUMPS — Oil- or Water-Lubricated

JOHNSTON PROPELLER and MIXFLOW PUMPS — For Large Capacity At Low to Medium Heads

Books you may want

Marine Geology, *Ph. H. Kuenen, John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Pages, 568. Price, $7.50.*

A summary of the present knowledge and controversial problems regarding the geology of the seas, this book discusses submarine landforms and their interpretation, the structure of atolls, the processes of sedimentation and many other subjects. Because of his experience as geologist for the Snellius Deep-Sea Expedition in the Moluccas, the author pays special attention to coral reefs, submarine canyons, and the Moluccan deep-sea troughs.

Professor and head of the geological department at the University of Groningen, Holland, Dr. Kuenen is currently director of the Foundation for Marine Geology at Groningen.

The Cylinder Wear in Diesel Engines, *by Carl Hegh Chemical Publishing Company, Inc., 26 Court Street, Brooklyn 2, New York. Pages 243. Price, $5.*

Everyone associated in any way with diesel engines, whether designer, builder, owner, or operator is interested in the subject of cylinder wear. The wear of pistons, rings, and cylinder walls is the greatest source of maintenance expense for diesel engines. If cylinder wear could be lessened the field of application of diesel engines could be expanded. Although cylinder wear has been given considerable study, the data has been scattered. The author has covered the subject in a thorough manner and has disclosed information in a single volume that should be of value to all connected with the diesel-power field.

Subsurface Woodford Black Shale, West Texas and Southeast New Mexico. *By Samuel P. Ellison, Jr. Published by Bureau of Economic Geology, The University of Texas, Austin 12, Texas. Pages, 20. Price, $.35.*

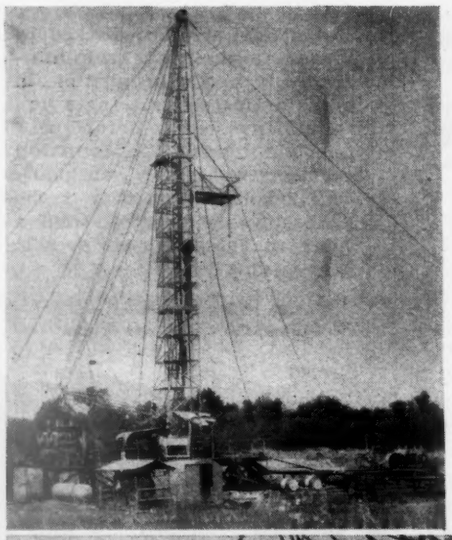
This pamphlet, the seventh in a series of report in investigations consists of 20 pages with 6 text figures. The report describes and illustrates the geographic distribution, lithology, thickness, and paleontology of the subsurface Woodford in the Permian basin.

Oil and Petroleum Year Book 1950. *Compiled and published by Walter E. Skinner, 20, Copthall Avenue, London E.C. 2. Pages, 280. Price, $4.*

The 41st issue of this standard reference work contains particulars concerning 790 companies operating in all parts of the world and covering all branches of the oil industry. The particulars of each company comprise names of directors and other officials, description of business, where operating, crude oil production, refinery runs, details of capital, dividends and financial results. It also contains the names and addresses of 470 managers and engineers and the names of the companies in the book with which they are connected.

The Chemical Formulary, *Volume IX, H. Bennett, Editor-in-Chief, Chemical Publishing Company, 26 Court Street, Brooklyn, N. Y.*

Thousands of industrial formulae and methods of their formulation are listed in this new volume of the series. Every formula is different from those of previous volumes and it represents new developments in each field covered. Formulae may be used for preparing products of a firm and they may also serve as a source of ideas and a starting point of experimentation for formulating different products. The book contains an alphabetical list of chemicals and trade mark products with the names of their manufacturers.

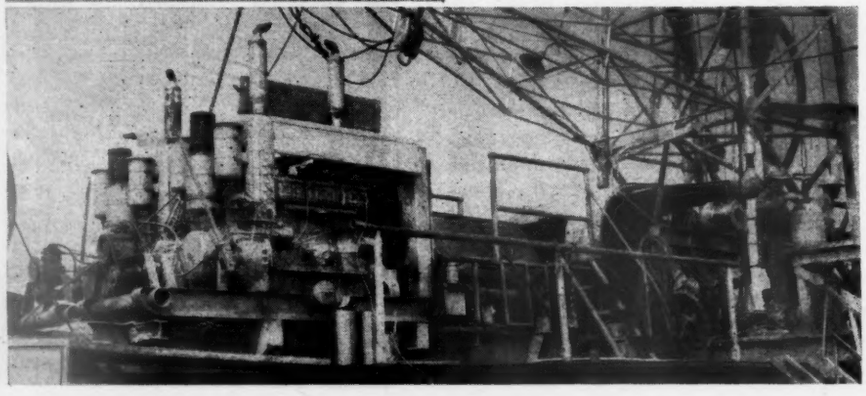


Beene-Hurley Use Low Cost Power on Frank's Rig!

Drillers Beene and Hurley at Bossier City, La., use Frank's portable rig with four Minneapolis-Moline 1210-12A units for power. They are drilling low-cost wells to depths of 6500 feet. The 1210-12A, 12 cylinder unit engines are factory equipped to operate on LP gas or natural gas—the low priced fuels in this area.

Beene and Hurley have mounted two of these units on the drilling table to furnish power to the draw works. These engines are equipped with front power take-off drives and supply 400 hp with LP gas. The other 1210-12A units are remotely located on the mud pump. The complete engineering and installation was done by Beene and Hurley at Shreveport.

Mud pump installation is powered by two MM 1210-12A's.



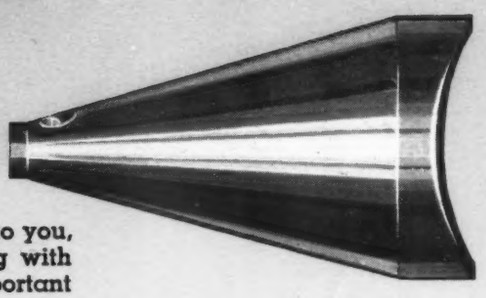
Two MM 1210-12 on the drilling table operate on low-cost, higher octane LP gas.

This arrangement combines flexibility of layout with important time saving for setting up the rig. Precision tooling and high production methods account for the extremely low selling price of MM heavy-duty oil field power units. Standardization of parts permits interchangeability which assures easier, lower-cost maintenance.

Sales and service of MM oil field engines are handled by the Shrimpton Manufacturing and Supply Co., with branches at Los Angeles, California; Oklahoma City, Oklahoma; and Kilgore, Texas.

AK-402

There's a LOT MORE to KONESHOT perforating than this



The deep penetration of shaped-charge perforating you know about. KONESHOT gives it to you, of course. But it's good to remember, that, along with deep penetration, KONESHOT gives you other important things, too.

There are the PLUS features

PERFORATING EXPERIENCE. The intimate knowledge of every oil field and every imaginable down-hole condition and problem which Lane-Wells has gained in doing more than 143,000 perforating jobs pays off for you on your jobs. Experience? ***LANE-WELLS HAS IT!***

ACCURATE DEPTH MEASUREMENTS. Deep penetration is valuable *only* when it goes where you want it. Lane-Wells individually-calibrated cables, micrometric measuring sheaves and other measuring devices have made Lane-Wells depth measurements the standard of the industry. ***LANE-WELLS HITS DEPTHS ON THE NOSE!***

SAFETY. Because the guns are *never* "live" until positioned in the shooting zone; because Lane-Wells uses a five-point safety switch system; because special precautions are taken with every KONESHOT charge; and because crews are carefully drilled in correct techniques, ***LANE-WELLS GIVES YOU SAFE OPERATIONS!***

YOU GET THE PLUS FEATURES IN KONESHOT PERFORATING

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AK-402

the mark of a good rock bit

THIS LABORATORY SHOT* shows the bottom pattern and clean, full-gauge perimeter possible with the Hughes Tri-Cone bit design. Better than any words, this hard, pink quartzite test block, having a compressive strength of 68,000 pounds per square inch, shows how efficiently this rock bit drills.

Naturally, we do not pretend that the bottoms of holes drilled in the field by Hughes bits are exact replicas of this, but we *do* think the picture depicts clearly the efficiency of the Hughes Tri-Cone design.

All Hughes Tri-Cone bits are especially designed to provide a balanced bit that is smooth running and free cutting. The spacing and angle of each tooth and row have been carefully selected to give maximum drilling speed and straight, full-gauge hole. The interfitting feature of the Hughes Tri-Cone bit, plus the scientifically-directed jetting action of the drilling fluid, assures most effective cleaning.

There is a Hughes Tri-Cone Rock Bit specially designed for each different formation. The experienced Hughes representative servicing your rig will be glad to help you select the proper type of rock bit for the particular formation you are drilling.

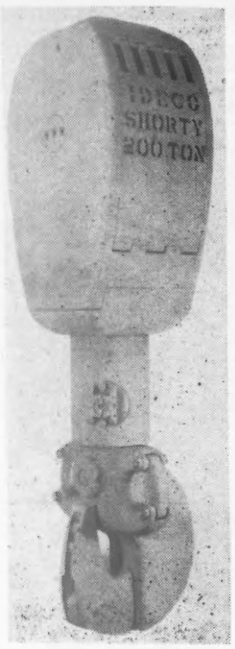
*Unretouched photo.

Hughes
TRI-CONE®
Rock
Bits

(23) Welding Unit

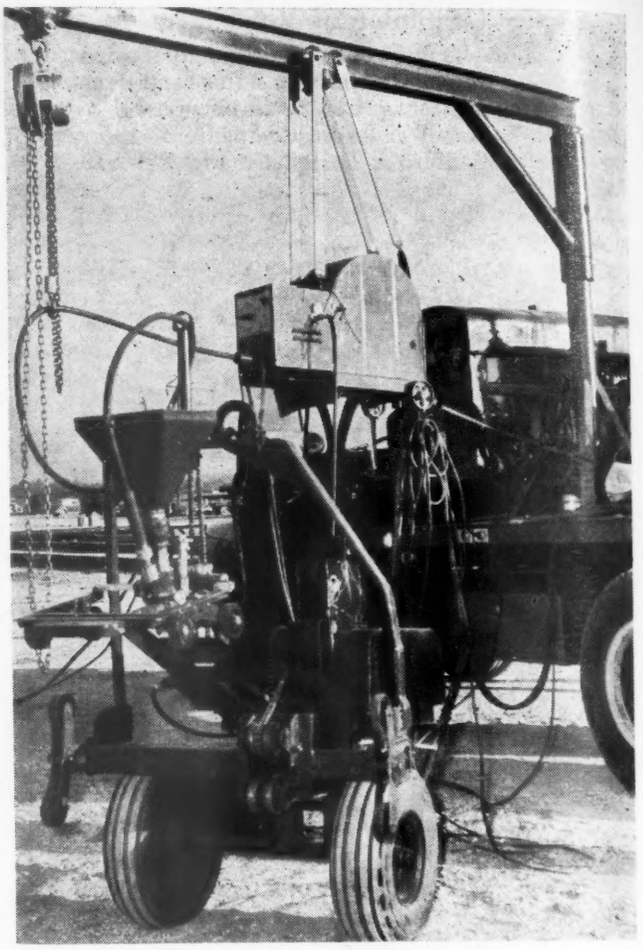
Hauser Pipe Line Equipment, Inc., Fort Worth, Texas, an affiliated company in O. R. Smith Contracting Corp., has developed a new portable pipe line welding unit, to be used in solving the problem of double-jointing and sectioning all sizes of pipe from 4-in. to 36-in. The unit consists of a pipe rolling rig mounted on pneumatic tires. An electric motor and a speed reducer provide the driving power through a chain that encircles the pipe. The pipe is supported on dollies designed to reduce rolling friction to a minimum and to prevent spiral motion as the pipe is rotated. A self adjusting arm, which is an integral part of the main frame, allows the welding carriage to ride on the outside surface of the pipe. A frame within the carriage, which has lateral adjustment, provides a mounting for the welding gun and the flux box.

Shorty Block



(24) Shorty Blocks

The International Derrick and Equipment Company, Dallas, Texas announces the addition of a 200 ton capacity block to their regular line of shorty blocks. These blocks have found wide acceptance among operators using drilling and servicing masts. They are unitized assemblies that combine the block, spring loaded link adapter and swivel bail hook into a short compact assembly. Added head room provided by this design permits faster operation as the pipe may be hoisted safely at full speed to the top of the run.



Portable pipe line welding unit.

(25) Automatic Titrator

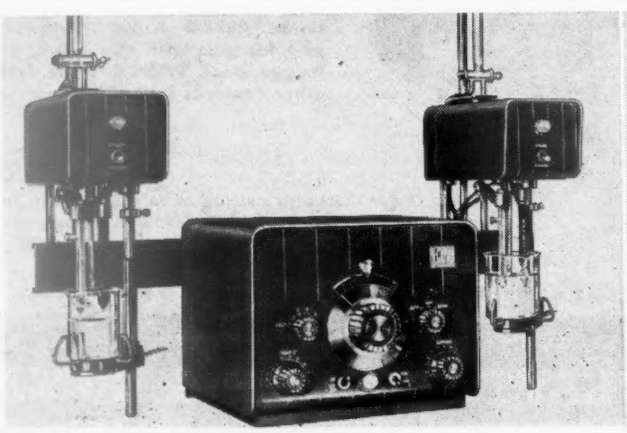
Beckman Instruments, South Pasadena, California, recently announced the Beckman automatic titrator. As its name implies, this new instrument handles routine titrations completely automatically. It makes accurate titrations more rapidly and conveniently than is possible by manual methods, and also gives objective, reproducible results that are free of errors due to personal factors. Further, it eliminates the eye-strain and fatigue caused by the close observation necessary in manual procedures. Operation is unusually simple and convenient.

(26) Process Pumps

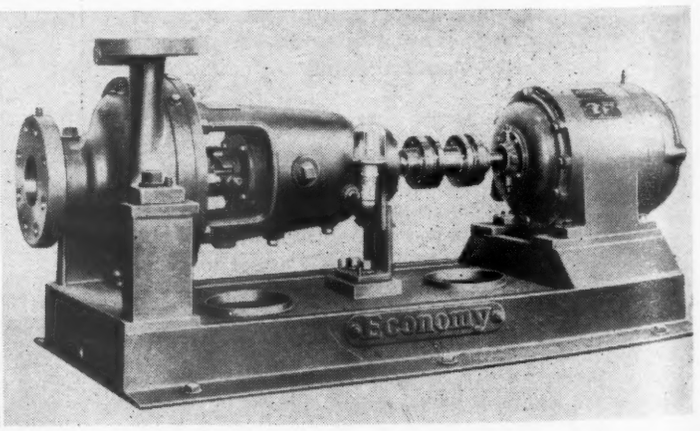
An improved line of pumps for process use has just been announced by Economy Pumps, Inc., division of Hamilton-Thomas Corporation, Hamilton, Ohio. Known as "Type Q" pumps, the new line is especially designed for use with Dowtherm hot oil, condensate, propane, butane, gasoline, chemical, and process liquors at temperatures up to 800 F. Although materials used in their construction varies for each particular application, "Type Q" pumps have common design features said to contribute greatly to performance.

(27) Heating Units

New serpentine flexible electric units which can be applied to pipes, valves, cylinders and containers carrying viscous or free-flowing fluids, chemicals, plastic compounds or gases have been announced by the Titan Manufacturing Company, Inc., Buffalo 2, New York. Sheathed in $\frac{5}{16}$-in. diameter spring steel, the units combine flexibility and strength with minimum bending radius of $\frac{1}{2}$-in. Due to refractory insulation, they can operate at temperatures approaching 1000 F for long periods. Standard units are 1 ft to 10 ft.



Beckman automatic titrator.



Economy pump for process use.